

BYTE

THE WORLDWIDE COMPUTING AUTHORITY



The Ultimate Workstation
for CAD/DTP, Page 192

Penny-Pinching PCs

from IBM,
Compaq, DEC,
AST, Dell,
and Apple:
How They Did It

PLUS

Xerox PARC's
Information
Theater

Compaq
Unveils
Network
Printers

Digital
Photography
Pros and Cons



Compaq
ProLine 3/25zs



Apple
Macintosh
Performa 600



IBM
PS/ValuePoint 32 XT

International Edition



£1.95 U.K./Lit.8,000 ITALY/\$3.50 U.S.A.
A McGraw-Hill Publication/0360-5280



Once upon a time, a band of young rebels known as Gateway 2000 launched a crusade against the tyranny of the PC Titans' bloated prices.

Price Wars raged between the Titans and the value-driven upstarts, but the lumbering giants could not match the speed or strength of the rebel attacks.

So the Titans plotted a crafty revenge. They'd cut quality and features, thereby to match the renegades' prices – an evil plan to fool PC buyers and chase the merry Gateway band right out of the forest!

With great fanfare, the Titans charged – only to fall into a clever trap! The woodsmen had crafted powerful new weapons – weapons smarter, better, harder-working and more value-packed than ever.

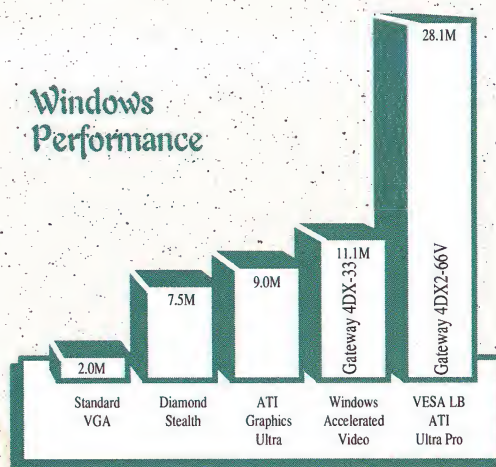
New Legends Are Born!

The rebels introduced a new product line with faster video, bigger hard drives, local bus and the latest processors. True to form, they boosted performance and lowered prices!

VESA Local Bus Systems

Unlike most proprietary implementations on the market, Gateway's local bus met VESA (Video Electronics Standards Association) compatibility standards. To get optimal performance from the local bus, the woodsmen added ATI's™ new Graphics Ultra Pro video system, with 1MB VRAM. The Ultra Pro is nearly three times faster than the older ATI Graphics Ultra, giving the new rebel systems incredible speed – up to 28 million Winmarks!

Windows Performance



Based on Winmarks. Video performance varies with processor speed.

Amazing as 28 million Winmarks is, this benchmark doesn't adequately show local-bus video performance. You just have to see it to believe it!

The wily woodsmen also put the IDE hard drive controller on the local bus for shining disk performance.

Faster Mini Desktop Systems

The renegades made powerful improvements to mini desktop systems, too. On these compact models, they put better, integrated motherboards, faster video, and on 486 models, high-performance local-bus hard drives.

And They Lived Happily Ever After

The Gateway arsenal was further fortified by other valuable features and products (described on the next page). And the people turned against the Titans' trickery and flocked to the banner of value.

Once again, there proved to be one strong and true victor in the Price Wars. Gateway 2000 remains the Champion of the People, and the best value prevails.

Gateway 2000

Remains The Champion Of The People!



With Great New Products.





**The PC Titans
Are Conjuring Up
A New Plan
To Catch The
Rebel Leader,
But...**

More Champion Values From Gateway 2000!

Road Warriors

Wherever you journey, our lightweight **Nomad** notebook computers give you desktop performance – in 386SX-25, 486SX-20 and 486DX-25 models.

You get 4MB RAM and 80 or 120MB hard drive, depending on the model; one of the biggest and brightest 10-inch backlit screens in the industry, with 640 x 480 resolution, 64 gray scale, on the LCD; our compact FieldMouse portable pointing device; patented power-management features for over six hours of operation from a single battery – and the Nomad with battery weighs less than six pounds! Plus it's made in the U.S.A.!

The **HandBook™** is a one-of-a-kind, real PC in miniature form! HandBook owners tell us you can carry it with you everywhere, to do all kinds of work – and it weighs so little, you have to check your briefcase to make sure it's there!

The HandBook weighs just 2.75 pounds and measures about 6 x 9 inches, yet delivers 286-class performance for all your DOS applications. You get a bright, backlit screen; 40MB hard drive; a comfortable 78-key keyboard and up to 4.5 hours of battery life with power management.

Bountiful Software

Every Gateway system includes free software; check our system configurations on the back page of this ad for details. All software is installed at our factory, tested, and ready to run – master diskettes and comprehensive manuals provided.

► **NEW!** Our Cool Tools for DOS is a utilities software package that comes with all Gateway desktop systems, including: QA Plus™ from DiagSoft™ (for diagnostic hardware testing), Central Point® Anti-Virus, RAM Boost, Defrag and Emergency Disk (for recovering your precious data if you have hard drive problems).

If your system includes "choice of application software," pick one from the following popular applications, all latest versions:

- **NEW!** Microsoft® Word and Bookshelf® 92, CD-ROM edition, takes the most popular word processor for Windows and adds an entire electronic reference library full of multi-media sights and sounds.
- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- Borland Paradox® and Turbo Pascal or C++®

- The MS Entrepreneur Pack (Works™, Publisher™, Money™, and Games)
- The Windows Programmer Pack (MS QuickC™, Visual Basic and more)

You can also upgrade to Microsoft Office™ for \$175.

Peripherals At Gallant Prices

NEW! Microsoft Windows Sound System™

Designed especially for business use. Voice recognition lets you "speak" commands to your PC for hands-free operation – and your PC can read numbers back to you for proofreading! Embed audio messages in Windows OLE applications, and add audio to screen savers. Full Adlib compatibility. Package includes soundboard, microphone, headset and software.

► **\$149** (with the purchase of a system)

NEW! CD-ROM Kit

Includes interface card and everything you need to add CD-ROM to your PC. Manufactured for Gateway by Sony® MPC-compliant.

► **\$225**

CrystalScan 15-Inch Monitor

Non-interlaced 15-inch color monitor with flat, square screen – an upgrade option with the purchase of any Gateway 2000 desktop system.

► **\$125** (upgrade price)

The TelePath™ Fax/Modem

A 14,400 bps mode, V.32bis, with 9,600 bps fax capability. Includes WinFax Pro™, Crosstalk™ for Windows, Qmodem™ and more.

► **\$195**

Also available – printers, tape backups and other peripherals. Call for details. (Sorry – we sell components, peripherals and software only with the purchase of a system, or to previous customers.)

Extras From Merry Gateway

- One-year limited warranty
- 30-day money-back guarantee
- Free on-site service to most locations (factory service only for notebooks)
- Lifetime BBS membership and toll-free technical support

PORTABLE SYSTEMS

HANDBOOK™

- ▶ 286-Class Performance
- ▶ 1MB RAM upgradeable to 3MB
- ▶ 40MB Hard Drive
- ▶ Backlit 7.6" CGA Screen
- ▶ Size 5.9" x 9.75" x 1.4", 2.75 Lbs.
- ▶ 4.5-Hr. NiMH Battery & AC Pack
- ▶ 1 Parallel/1 Serial Port
- ▶ 78-Key Keyboard
- ▶ MS-DOS® 5.0, LapLink® XL, MS Works™, Central Point® Desktop & Serial Download Cable.
- ▶ Carrying Case

\$1295

NOMAD 325SXL

- ▶ 25MHz 386SXL Processor
- ▶ 4MB RAM
- ▶ 3.5" Diskette Drive
- ▶ 80MB IDE Hard Drive
- ▶ Backlit 10" VGA Screen, 64 Grays
- ▶ Simultaneous Video with 256K
- ▶ Size 8.5" x 11" x 1.8", 5.8 Lbs.
- ▶ 6-Hr. NiCad Battery & AC Pack
- ▶ 1 Parallel/1 Serial Port
- ▶ 79-Key Keyboard & FieldMouse™
- ▶ MS-DOS 5.0 and Windows™ 3.1
- ▶ MS Works for Windows™ 2.0

\$1995

NOMAD 420SXL

- ▶ 20MHz Intel® 486SXLP Processor
- ▶ 4MB RAM
- ▶ 3.5" Diskette Drive
- ▶ 80MB IDE Hard Drive
- ▶ Backlit 10" VGA Screen, 64 Grays
- ▶ Simultaneous Video with 1MB
- ▶ Size 8.5" x 11" x 1.8", 5.8 Lbs.
- ▶ 6-Hr. NiCad Battery & AC Pack
- ▶ 1 Parallel/1 Serial Port
- ▶ 79-Key Keyboard & FieldMouse
- ▶ MS-DOS 5.0 and Windows 3.1
- ▶ MS Works for Windows 2.0

\$2495

NOMAD 425DXL

- ▶ 25MHz Intel 486DXLP Processor
- ▶ 4MB RAM
- ▶ 3.5" Diskette Drive
- ▶ 120MB IDE Hard Drive
- ▶ Backlit 10" VGA Screen, 64 Grays
- ▶ Simultaneous Video with 1MB
- ▶ Size 8.5" x 11" x 1.8", 5.8 Lbs.
- ▶ 6-Hr. NiCad Battery & AC Pack
- ▶ 1 Parallel/1 Serial Port
- ▶ 79-Key Keyboard & FieldMouse
- ▶ MS-DOS 5.0 and Windows 3.1
- ▶ MS Works for Windows 2.0

\$2995

DESKTOP SYSTEMS

3SX-25

- ▶ 25MHz Intel 386SX Processor
- ▶ 4MB RAM
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 80MB 17ms IDE Hard Drive
- ▶ Windows Accelerated Video with 1MB DRAM
- ▶ 14" Color CrystalScan 1024
- ▶ Mini Desktop Case
- ▶ 5 16-Bit ISA Slots
- ▶ 124-Key AnyKey™ Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ MS Works for Windows 2.0

\$1295

4SX-25

- ▶ 25MHz Intel 486SX Processor
- ▶ 4MB RAM
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 120MB 15ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ Windows Accelerated Video with 1MB DRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Mini Desktop Case
- ▶ 5 16-Bit ISA Slots
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ MS Works for Windows 2.0

\$1495

4SX-33

- ▶ 33MHz Intel 486SX Processor
- ▶ 4MB RAM, 64K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 170MB, 13ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ Windows Accelerated Video with 1MB DRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Mini Desktop Case
- ▶ 5 16-Bit ISA Slots
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$1695

4DX-33

- ▶ 33MHz Intel 486DX Processor
- ▶ 4MB RAM, 64K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 200MB 13ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ Windows Accelerated Video with 1MB DRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Mini Desktop Case
- ▶ 5 16-Bit ISA Slots
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$1995

4DX-33V

- ▶ 33MHz Intel 486DX Processor
- ▶ 8MB RAM, 64K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 200MB 13ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ VESA Local Bus ATI Ultra Pro with 1MB VRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Desktop Case (Tower Upgrade)
- ▶ 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus Extensions
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$2395

4DX2-50V

- ▶ 50MHz Intel 486DX2 Processor
- ▶ 8MB RAM, 64K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 200MB 13ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ VESA Local Bus ATI Ultra Pro with 1MB VRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Desktop Case (Tower Upgrade)
- ▶ 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus Extensions
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$2595

4DX2-66V

- ▶ 66MHz Intel 486DX2 Processor
- ▶ 8MB RAM, 64K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 340MB 13ms IDE Hard Drive
- ▶ Local Bus IDE Interface
- ▶ VESA Local Bus ATI Ultra Pro with 1MB VRAM
- ▶ 15" Color CrystalScan 1572FS
- ▶ Desktop Case (Tower Upgrade)
- ▶ 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus Extensions
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$2995

4DX2-66E

- ▶ 66MHz Intel 486DX2 Processor
- ▶ 8MB RAM, 128K Cache
- ▶ 5.25" & 3.5" Diskette Drives
- ▶ 500MB 11ms SCSI Hard Drive
- ▶ 32-Bit EISA SCSI Controller
- ▶ Windows Accelerated Video with 1MB DRAM
- ▶ 14" Color CrystalScan 1024NI
- ▶ Tower Case
- ▶ 8 32-Bit EISA Slots
- ▶ 124-Key AnyKey Keyboard
- ▶ MS-DOS, Windows & Mouse
- ▶ Cool Tools for DOS
- ▶ Choice of Application Software

\$3795

Please call for other configurations. We custom-build each Gateway 2000 system to your specifications.



Printed on
recycled paper.



8 0 0 - 5 2 3 - 2 0 0 0

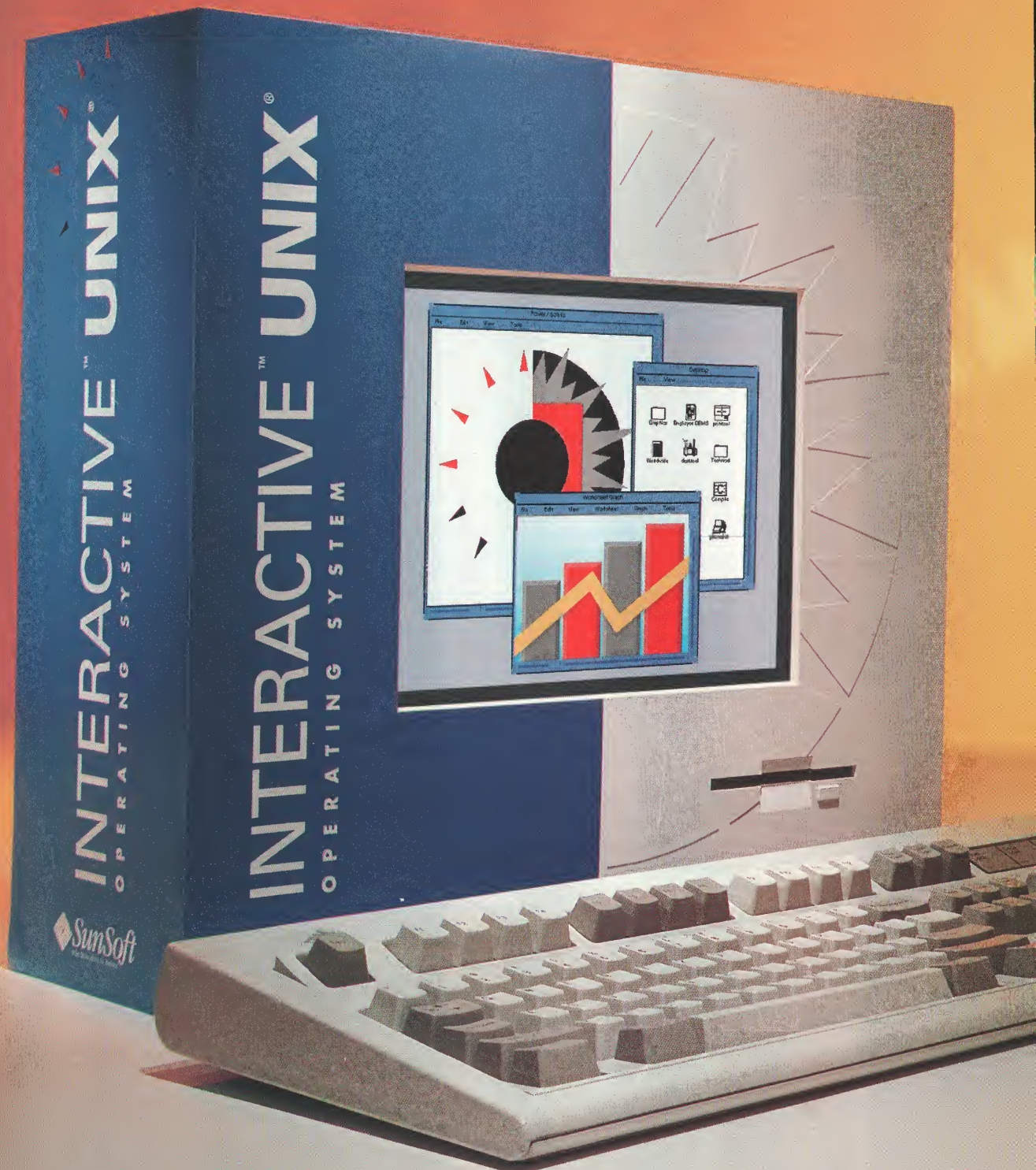


610 Gateway Drive • P.O. Box 2000 • North Sioux City, SD 57049-2000 • 605-232-2000 • Fax 605-232-2023

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

©1992 Gateway 2000, Inc. AnyKey, HandBook, FieldMouse and TelePath are trademarks of Gateway 2000, Inc. Intel is a trademark of Intel Corporation.

All other brands and product names are trademarks or registered trademarks of their respective companies. Prices and configurations are subject to change without notice. Prices do not include shipping.



So Powerful It Can't Be A PC.

Transform Your PC With The INTERACTIVE UNIX System.

Unleash the 32-bit power in your PC with the INTERACTIVE™ UNIX® System from SunSoft. Charge through applications at record speeds. Use real-world multitasking and networking. Get on the path to a distributed computing future.

Just Say No To SCO.

Why? The INTERACTIVE UNIX System is easy to use, simple to administer, all at a great price.

*Open Systems Today** says the INTERACTIVE UNIX "system management...is easier to use and more comprehensive" than SCO™ and "is simply a masterpiece of good design."

Looking Glass Professional™ desktop manager makes the INTERACTIVE UNIX System easy enough for novices, yet powerful enough for experienced UNIX users. And the award winning Easy Windows makes setting up graphic environments infinitely simpler.

You can't afford *not* to take advantage of the already low cost of the INTERACTIVE UNIX System.

And SCO UNIX/XENIX® users can save an additional 50% by switching to the INTERACTIVE UNIX System today. That's something to say yes to.



Everything You Like About Your PC—And A Lot More.

INTERACTIVE UNIX System V/386 Release 3.2 supports hundreds of the most popular Intel-based platforms and peripherals. So getting started is fast, easy, and cost-effective.

Thousands of UNIX and XENIX applications are at your command. And our VP/ix package runs virtually all DOS software.

You get Lotus™, WordPerfect®, and Oracle®. You get SCO applications. You get it all.

See What Develops.

The INTERACTIVE UNIX System is the environment of choice for 80X86 application development. You get access to a full range of development tools including compilers, debuggers and libraries. And for graphical applications, the X11 INTERACTIVE environment is a revelation.

Partner With Power.

The INTERACTIVE UNIX System is a powerful business partner for companies who know something about power. Companies like BMW, Goodyear, Leica, and Dunlop to name a few. That power can be yours, too. All from SunSoft, the leading supplier of 32-bit UNIX system software.

Call today and save 50% on UNIX power that's so cost-effective, it can't be anything *but* a PC. 1-800-227-9227.

 **SunSoft**
A Sun Microsystems, Inc. Business

COVER STORY

FEATURE

Penny-Pinching PCs: How They Did It

PAGE 128

NEWS

- 28 MICROBYTES**
With Microsoft's Windows NT nearing availability, IBM is working hard to improve OS/2 2.0.
- 45 REPORT FROM SÃO PAULO**
by Stephen Banker
Over 450,000 people jam Brazil's Fenasoft software show.
- 50 FIRST IMPRESSIONS**
New Systems...New IBM?
by Ed Perratore
Big Blue comes out swinging.
- 52 Windows for Workgroups**
by Jon Udell
Peer-to-peer networking and more with Windows for Workgroups.
- 58 LANtastic for Macintosh,**
Artisoft's PC-to-Mac connectivity solution offers power, simplicity, and low cost
- Windows Sound System**, Microsoft enters the sound board market
- Infolio**, have pen computer, will travel
- DOC.IT**, a printer, fax, copier, and scanner all in one
- Quicken 2.0 for Windows**, new features make this popular finance program even better
- Optique 4000D and HiColor Turbo F/X**, a winning color combination
- Ways for Windows**, translation the easy way
- 76 WHAT'S NEW**
The Freestyle/SL Notebook's screen swivels; IDL for Windows lets you do high-power scientific computing; and more.

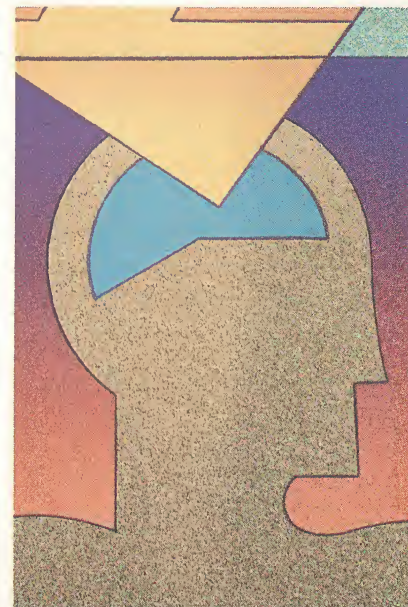


FEATURES

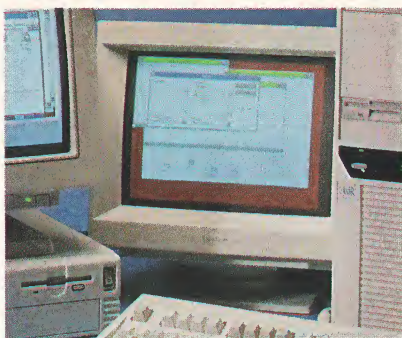
- 128 Penny-Pinching PCs: How They Did It**
by Andrew Reinhardt
Low-priced PCs bring benefits—and risks—to buyers.
Less Expensive, or Cheap?
by Steve Apiki and Tom Thompson
- 139 Smile for the Computer**
by Philip Chien
Your computer might be your camera's best accessory.
- 145 The Information Theater**
by Mark A. Clarkson
Xerox PARC presents a new way to view your data.

STATE OF THE ART

- SIGNAL COMPUTING**
- 154 Overview: Signal Computing**
by Eric C. Anderson, Stephen Shepard, and Phil Sohn
Watch for hazards when moving information from the analog to the digital realms.
Digitally Speaking
by Georges Zanellato and Bart Verhaeghe
- 167 Signals on the Desktop**
by John Bryan
You don't have to wait for DSP technology; it's here today.
- 177 Inside Signal Computing**
by Peter Wayner
The architecture of DSP chips mirrors the functions they perform.
- 185 A Platform for Signal Computing**
by Tim Counihan
The signal-computing environment tries to set a signal-computing standard.
- 190 Resource Guide: DSP-Based Products**



- 192 SOLUTIONS FOCUS**
Stalking the Ultimate Workstation
by Ben Smith and Raymond GA Côté
 Eight powerhouses reviewed.
- 209 BYTE Lab Product Report** ▷
486 Systems for a Graphical World
by Howard Eglowstein and Stan Wszola
 The best 33-MHz 486 systems for today's demanding applications.
- 238 Cut to Video: Four Programs for Moving Presentations**
by Tom Yager
 The BYTE Lab looks at four video-presentation programs.
- 249 Compaq Unveils a New Network Printer**
by Greg Loveria
 Compaq enters the printer market with the powerful Pagemarq line.
- 253 Borland Targets Windows Developers with Latest C++ Release**
by Othar Hansson
 Borland C++ 3.1 contains some features we've been waiting for.
- 256 Sophisticated Graphing Under Windows**
by D. Barker
 DeltaGraph Professional brings good chart-making tools to Windows.



- 261 Style Meets Substance in Matrox Studio**
by Tom Yager
 Studio turns your PC into a video powerhouse.
- 265 LANlord Evicts LAN Problems**
by Barry Nance
 Microcom's high-level LAN manager uses OS/2 to manage DOS and Windows workstations.
- 269 Network Modems Dial in, Dial out, and Route Packets**
by Steve Apiki, Tom Thompson, and Jon Udell
 Microtest's Lanmodem versus Shiva's NetModem/E.
- 276 Reviewer's Notebook: The BYTE Lab, Behind the Scenes**
by Alan Joch
 An invitation to look over the shoulders of our testing editors.

HANDS ON

- 281 SOME ASSEMBLY REQUIRED**
Approximate Pattern Matching
by Udi Manber and Sun Wu
 Agrep's algorithms let you perform text searches using an approximate pattern.
- 293 UNDER THE HOOD**
A Call to ARM
by Dick Pountain
 The 32-bit ARM610 is a high-performance, power-saving RISC CPU in a tiny package.
- 299 SOFTWARE CORNER**
BASH, the Bourne Again Shell
by Ben Smith, Tom Thompson, and Steve Apiki
 A free Korn-shell replacement, a JPEG viewer for Macs, and a Windows file utility.
- 301 BEYOND DOS**
An Objective Way to Compute
by Bruce D. Schatzman
 The object-based model in Windows NT forms the foundation for Microsoft's future operating systems.
- 303 ASK BYTE**
 Winnowing down Windows; BYTE listings on UUNET; getting from CP/M to MS-DOS; and more.

- 109 USER'S COLUMN**
Pondering OS/2
by Jerry Pournelle
 OS/2 invades Chaos Manor.
- 278 BOOK AND CD-ROM REVIEWS**
Amok in Cyberspace
by Hugh Kenner, Raymond GA Côté, Tom Thompson, and Stanford Diehl
 A look at *The Hacker Crackdown*, *Macintosh Programming Secrets*, *Support on Site*, and other selections.
- 372 STOP BIT**
Artificial Life and Natural Markets
by Esther Dyson
 Parallels between artificial life experiments and competitive markets demonstrate the advantages of a free-market system.
- 12 EDITORIAL**
PCs Will Become More Personal
by Dennis Allen
- 22 LETTERS**
 How to get Unix for free; OS/2 2.0 defended; clarifying the A20 problem; and other issues.

READER SERVICE

- 370 Editorial Index by Company
 366 Alphabetical Index to Advertisers
 368 Index to Advertisers by Product Category
 Inquiry Reply Cards: 144A, 368A

BUYER'S GUIDE

- 307 Mail Order
 Hardware/Software Showcase
 Buyer's Mart

PROGRAM LISTINGS

From BIX: Join "listings/frombyte92"

INSIDE BYTE

THE PAPERLESS OFFICE FOR ONLY \$6995.



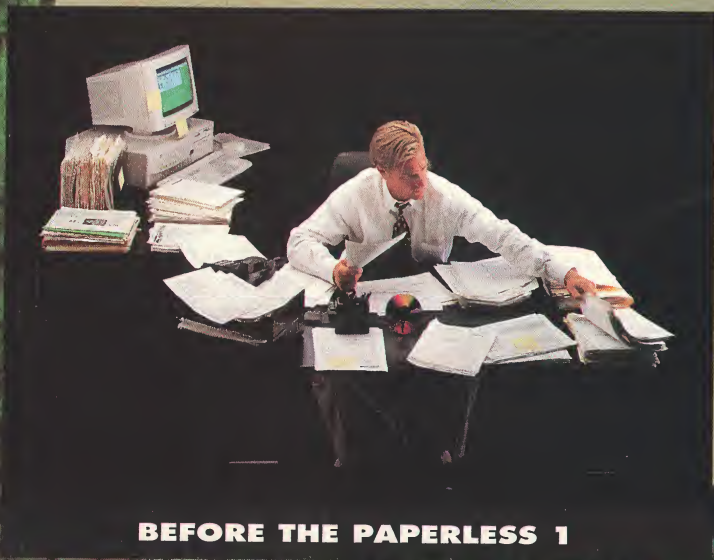
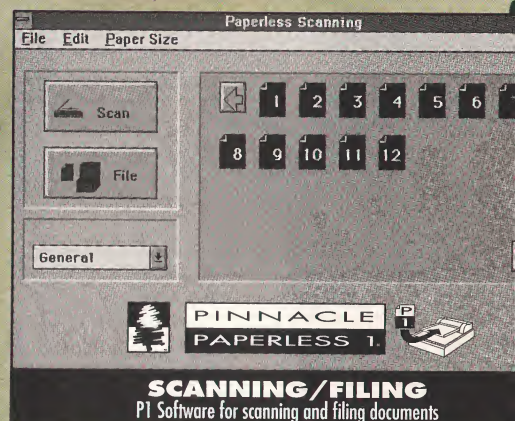
Introducing the Paperless 1,
a complete imaging system that
will change the way you store

and distribute paper forever.

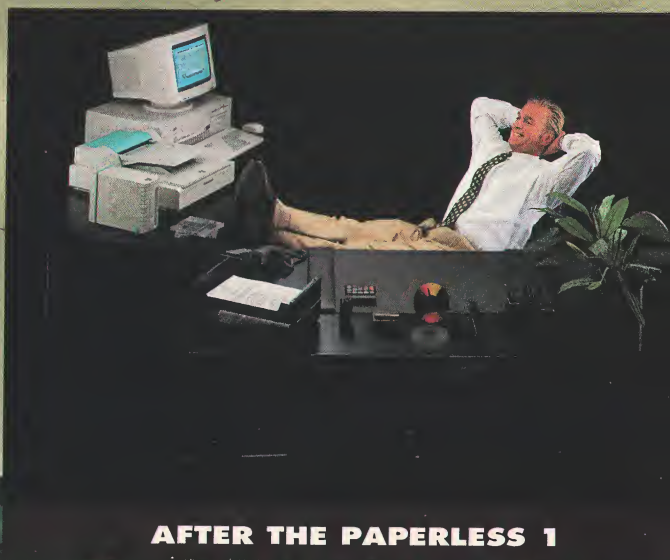
The P1 connects directly to any PC or MAC computer

and within minutes your system is ready to use. It's as easy to use as a copy machine.

It saves paper. It saves documents. It saves time. even saves trees...



BEFORE THE PAPERLESS 1

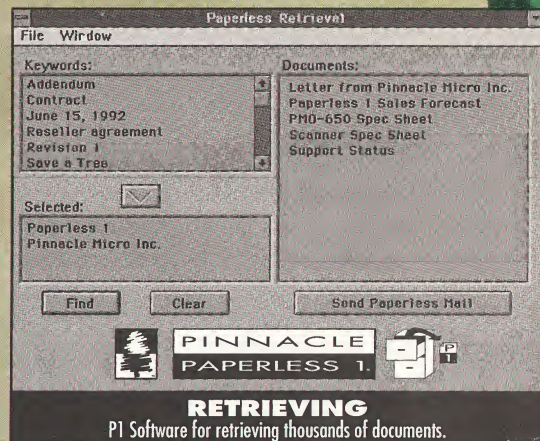


AFTER THE PAPERLESS 1

You can create a paperless copy and distribute it to any Novell® or AppleShare™ networked computer.

You can file millions of paper documents electronically and retrieve them with the click of a mouse.

The Paperless 1 brings document imaging to your desktop personal computer. It's Easy-to-Use, Powerful and Inexpensive.



THE COMPLETE P1 IMAGING SYSTEM

And with every purchase of a Paperless 1 system you will become a free charter member of the World Wildlife Fund.®

To receive a free catalog, on recycled paper, of the Paperless 1 system call:

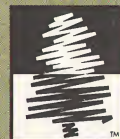
(800) 553-7070



World Wildlife Fund

Pinnacle Micro is proud to support conservation efforts of World Wildlife Fund. With each Paperless 1 purchase a portion of the proceeds is received by WWF.

Circle 174 on Inquiry Card (RESELLERS: 175).



**PINNACLE
PAPERLESS 1.**

19 TECHNOLOGY • IRVINE, CA 92718 • U.S.A. • INT'L (714) 727-3300 • FAX (714) 727-1913

Pinnacle Micro, P1, Paperless 1 and Pinnacle Micro Imaging are trademarks of Pinnacle Micro Inc. All other trademarks and registered marks to their respective owners.

INSIDE **BYTE**

BYTE Topic Index

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 370), you can identify articles by type, subject, title, author, or product discussed.

AMIGA 22, 109, 192, 278	E-MAIL 28, 52, 145, 276	NETWORKING 22, 52, 58, 76, 265, 269	SCSI 109
ADVANCED RISC MACHINE 293	ETHERNET 76	OPTICAL CHARACTER RECOGNITION 109, 303	SOUND 58, 109, 128, 238, 261
ARTIFICIAL LIFE 372	FAX/MODEMS 58, 76, 109, 249, 269	OS/2 22, 28, 109, 192, 209, 265	SPARC 177
BUSINESS 58, 76, 238, 256, 261	FREEWARE/SHAREWARE 299	PASCAL 28	SPEECH 154, 167
CAD 76, 192, 209	GRAPHICS 58, 238	PCMCIA 28, 58	STORAGE 76, 303
CD-ROMS 22, 52, 58, 76, 109, 128, 139, 167, 192, 278	ISDN 76, 167	PEN COMPUTING 50, 58, 76	TEXT RETRIEVAL 145, 281
CHIPS 28, 128, 293	KEYBOARDS 76, 209	PHOTO CD 139	UNIX 22, 45, 76, 192, 209, 253, 276, 281, 299, 303
COMMUNICATIONS 22, 269	LAN MANAGER 265	PHOTOGRAPHY 139	VGA 58
COMPILER 253	LAPTOP 22, 28	PORTABLES 22, 28, 45, 50, 76	VIDEO 238, 261, 303
DATABASES 145	LOW-COST SYSTEMS 50, 128	PRESENTATIONS 238	VOICE 76
DESKTOP PUBLISHING 192, 303	MACINTOSH 28, 58, 76, 128, 167, 256, 269, 276, 278, 299	PRINTERS 58, 76, 249, 256	WINDOWS 22, 28, 45, 52, 58, 76, 109, 209, 249, 253, 256, 261, 265, 299, 301, 303
DOS 22, 28, 45, 52, 76, 109, 167, 192, 209, 249, 253, 265, 269, 276, 303	MIDI 58	PROGRAMMING 28, 76, 109, 253, 278, 281, 293, 299, 301	WORKSTATIONS 192, 265, 276
DRAWING 256	MONITORS 58, 76, 109, 128, 139, 209, 238	RISC 58, 177, 192, 276, 293	X WINDOW SYSTEM 22, 76, 192
DRIVES 76, 109, 128, 209, 303	MULTIMEDIA 58, 76, 109, 238, 261	SCANNERS 58, 76, 192	
DIGITAL SIGNAL PROCESSORS 128, 154, 167, 177, 185, 190	MUSIC 109	SCHEDULING 76	
	NETWORK MANAGEMENT 265	SCIENCE 76, 209, 372	

Three Good Reasons for Choosing Videx Bar Code Readers:



Portable



Durable



Programmable

Proven performers in any environment—from the office to the outdoors—Videx's family of bar code readers leads the industry as the most portable, durable, programmable data collectors. Make your job easy. Keep track of time, attendance, assets, inventory, work-in-process, shipping and receiving with a bar code reader from Videx®.

TimeWand® I, DuraWand™, and TimeWand II are designed for today's world of diverse applications and

demanding environments. All at prices that make them the obvious choice.

TimeWand I	\$248
DuraWand	\$495
TimeWand II	\$698

For a free information kit, call Videx today at 503-758-0521.



See us at Comdex Fall, Nov. 16-20, Las Vegas, booth #2974.

Videx, Inc., 1105 NE Circle Blvd., Corvallis, OR 97330-4285 • 503-758-0521 • FAX 503-752-5285

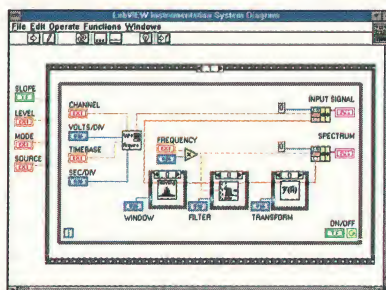
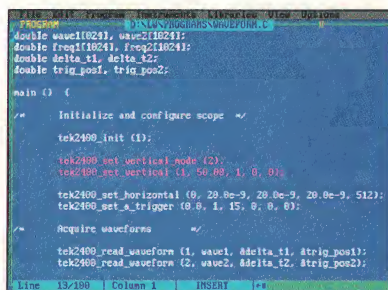
Videx and TimeWand are registered trademarks and DuraWand is a trademark of Videx, Inc. **Circle 216 on Inquiry Card**

The Software is the Instrument ... You Choose the Computer

LabWindows for DOS

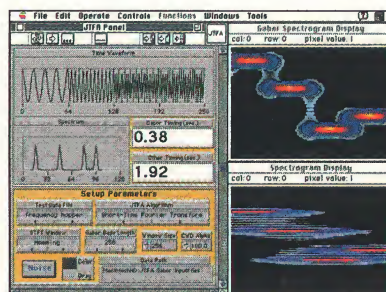
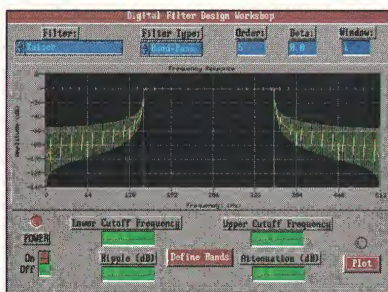
NEW LabVIEW for Windows
NEW LabVIEW for Sun
NEW LabVIEW for Macintosh

ACQUISITION



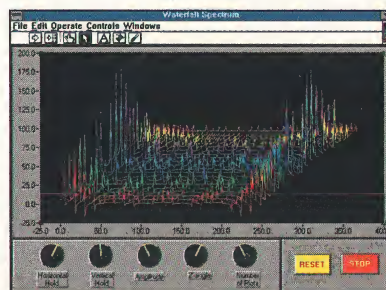
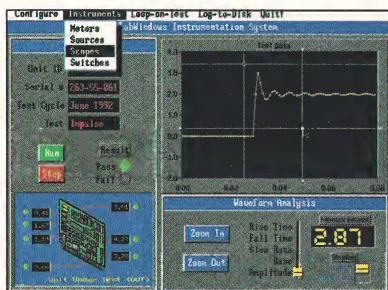
GPIO • Data Acquisition • VXI • RS-232 • Instrument Drivers

ANALYSIS



DSP • Statistics • Linear Algebra • Filters • Windows

PRESENTATION



Graphical User Interface • Hard Copy • File I/O

C and BASIC Programming

Graphical Programming

Call for FREE demo disks
(800) 433-3488 (U.S. and Canada)



Branch Offices: Australia 03 879.9422 • Belgium 02 757 00 20 • Canada 519 622 9310
Denmark 45 76 73 22 • Finland 90 524566 • France 1 48 65 33 70 • Germany 089 714 50 93
Italy 02 48301892 • Japan 03 3788 1921 • Netherlands 01720 45761 • Norway 03846866
Spain 91 896 0675 • Sweden 08 984970 • Switzerland 056 27 00 20 • U.K. 0635 523545
© Copyright 1992 National Instruments Corporation. All rights reserved. Product and company names listed are trademarks or trade names of their respective companies.

NATIONAL INSTRUMENTS®
The Software is the Instrument®

6504 Bridge Point Parkway
Austin, TX 78730-5039
Tel: (512) 794-0100
Fax: (512) 794-8411

Circle 158 on Inquiry Card.

See us at COMDEX, booth S2694; and at WESCON, booth 2457

Soon, Eight Hours Computing Will



(actual size)

AMD Introduces The World's First 386 Microprocessor With 3-Volt Technology.

Two standard dry-cell batteries. There's really nothing special about them. Aside from the fact that they can run a powerful, portable 386 computer for a full eight hours. Provided, of course, that portable is built around a low-voltage Am386™ microprocessor.



The 25MHz DXLV and the 25MHz SXLV are available in PQFP packaging.



Thanks to the low-voltage Am386 microprocessors, laptop, palmtop and notebook computer designs will become smaller, lighter, and more powerful than ever before.

With battery life of up to eight hours or more. That's a full day's worth of 386 performance—the per-

urs Of Portable Look Like This.

formance you need to run sophisticated applications like Windows™ 3.0.

And rest assured, the low-voltage Am386 microprocessors are proven compatible and comply fully with JEDEC standards for low-power, 3-volt computing. We can even supply you with the 3-volt EPROMs your systems will need. Other 3-volt system logic is also readily available.

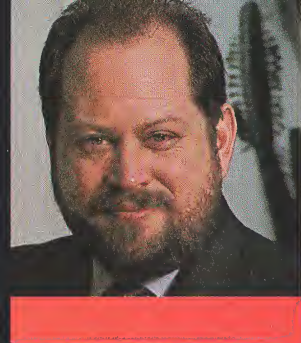
For more information on the low-voltage

Am386 microprocessors call AMD today at **1-800-222-9323**. You'll never look at dry-cell batteries the same way again.



Advanced Micro Devices

"We're Not Your Competition."™



DENNIS
ALLEN

EDITORIAL

PCs WILL BECOME MORE PERSONAL

The real impact of low-price computers is empowered users

When we first set out to learn how the major computer makers cut corners to lower prices, we didn't know exactly what we would find. All we knew for sure was that manufacturers must be doing *something* different to lower prices so dramatically. And to be honest, we were cynical enough to think we just might find that corners had been cut so much that the resulting computers would be less than desirable.

Our cynicism proved to be invalid, but that gives us something else to consider: Given that manufacturers can make low-price computers without necessarily sacrificing quality,

what impact will low-price computers have?

Before answering that question, consider the current situation. So far, the price war has yielded 486-based computers with enough memory, disk storage, and adequate graphics to run virtually any major software application satisfactorily at prices that start under \$2000. And if you shop around, you can find 386SX-based systems for less than \$1000 that are adequate for many applications.

Plus, you can buy those systems not just through mail-order suppliers, but also at department stores. Remember that we're not talking about toy computers; these are high-powered computer systems that you can buy in the same stores where you might purchase a VCR or camcorder. In fact, nowadays you might even pay more for a camcorder than for a computer.

The point is that a lot of high-powered computers are being offered—and sold—through traditional consumer channels. To be sure, some of those sales are for businesses, but often individual consumers are buying single units. To put it another way, the home computer has arrived, and it's not exactly wimpy.

It's too soon to have hard numbers on exactly how many computers are being sold into the home, but it is happening in a big way. The next time you visit the local shopping mall, stop by the computer section of one of the department stores and watch what is happening. You'll see people—sometimes whole families—buying a computer system for their home just as they would buy a new VCR. Even if you don't have time to visit the mall, your friends have probably asked you for advice as to which computer they should buy for their home.

These home-computer users will undoubtedly have new and different needs from current business users. Instead of complex workgroup solutions, their needs are

likely to be of a more "personal" nature that a single user experiences. And you can bet that some creative folks are ready and willing to address those needs.

It's even ironic that when most of the computer industry is focused on solving enterprise-wide computing problems with complex operating systems and workgroup software, a new community of users is emerging that will demand that their computers be *more* personal.

The result will be more emphasis on solving a single user's problems, whether it be managing disk files or improving personal productivity. In many ways, this shift will mean a return to the roots of personal computing. In other words, even though network administrators may be taking greater control of PCs, a move is afoot to once again empower users.

As the price war causes the number of individual users to grow, more and more programs and peripheral hardware will be developed to address the specific needs of individual users, and that's good news for business.

Not everything should be networked and shared. There always has been and always will be a need for personal information in every organization. Maybe it's notes, confidential memos, a private phone directory, or background information on client contacts. Or maybe it's a PIM (personal information manager), a utility to automate particular tasks, or a software application peculiar to a particular job.

It all boils down to a matter of empowerment, and it was the concept of empowerment that started the PC revolution over a decade ago. Back then, it was a matter of processing information without being dependent on the company's mainframe. Now, it's a matter of regaining some of the personal control of networked PCs.

Of course, the trend is only emerging, yet it seems clear that something big—something important—is happening. Simply put, many products that will be created for individual users will transcend their home-computer beginnings and benefit networked users in business. And that's the real impact of low-price computers: empowered users.

—Dennis Allen
Editor in Chief

DEMAND PERFORMANCE

Introducing Paradox 4.0 for DOS

*The most
advanced database
is now the fastest*



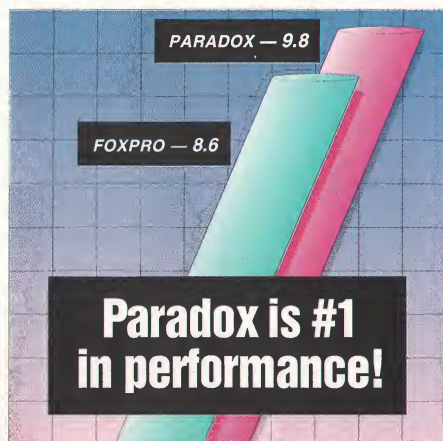
DEMAND



Paradox is fastest

NSTL results prove new Paradox® 4.0 is the world's fastest relational database! Thanks to Borland's new WarpSpeed™ performance, Paradox 4.0 sets the standard in performance for both network and standalone use. For you, this means faster answers to queries, faster memory access and faster multiuser applications.

In fact, Paradox 4.0 gives you unparalleled performance throughout all aspects of database management and application development. As NSTL put it, "Paradox is clearly the best all-around product evaluated." It beats FoxPro hands down.



Software Digest's NSTL report rates Paradox highest of all databases tested in Overall Power and Performance.

New Windows-like interface

Our new Windows-like interface makes using Paradox 4.0 more intuitive than any other database. Context-sensitive SpeedBar™ controls give you instant access to your frequently used commands and features. Movable, resizable windows, pull-down menus and mouse support make creating and editing your database simple. And new dialog boxes give you the choices you need in one place, saving time and effort.

The fastest way to get an answer

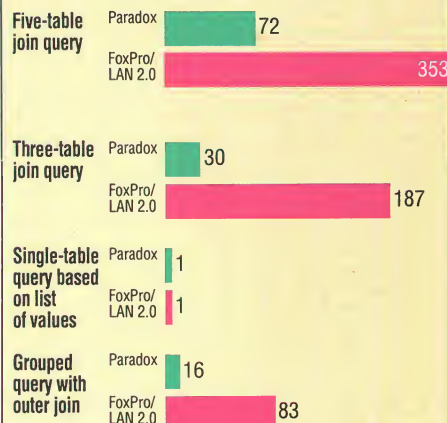
Paradox pioneered Query By Example (QBE), the easiest way to get answers from your database. Now, a built-in query optimizer enhances QBE, automatically finding the fastest path to the answers you're seeking. Plus, multi-table forms and reports make everything from data entry to presentations a snap—all without programming.

WarpSpeed

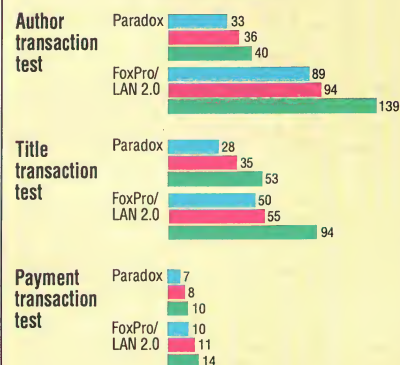
WarpSpeed stands for Wildly Accelerated Relational Performance. It reflects Borland's commitment to performance, and is also an integral part of our dBASE® and InterBase™ development programs.

NSTL tests confirm Paradox 4.0: Quicker than a Fox

Single-user performance tests (in seconds)



Multiuser performance tests (in seconds)



Multiuser Legend:

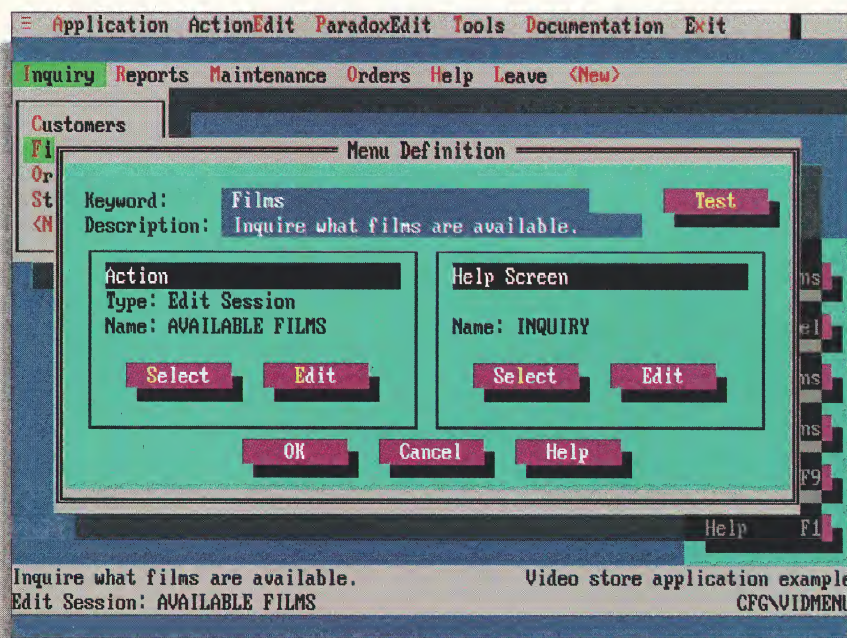
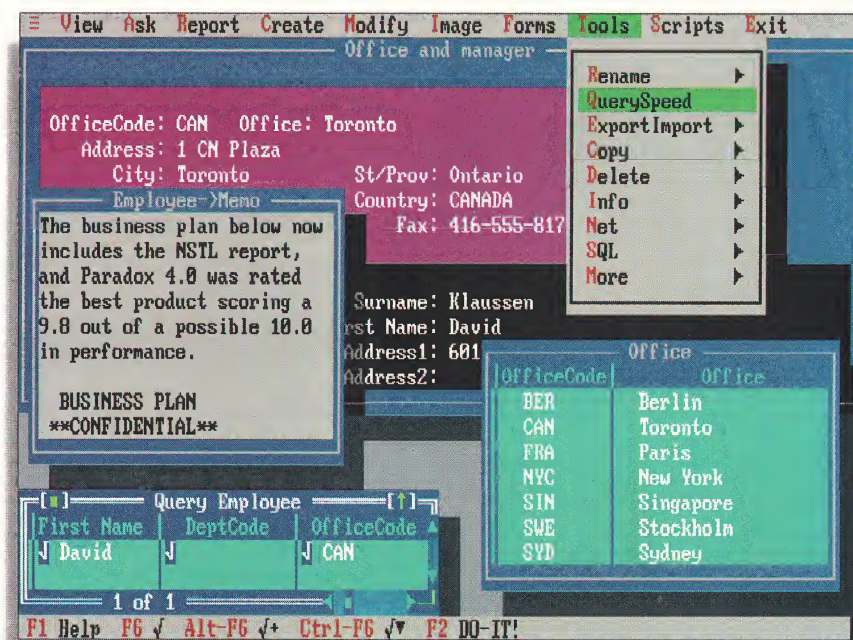
1 station (blue) 3 stations (pink) 8 stations (green)

To test the speed of transaction performance, NSTL designed a database for book order entry. Each record contained an author, a title, an ISBN number, a price and inventory information. The database contained 25,000 books and 5,000 authors.

PARADOX

New memo fields

Paradox 4.0 gives you the power to manipulate data you couldn't manage with ordinary databases. With new variable length memo fields, you have the ability to effortlessly manage large amounts of text information throughout your applications. And you can store anything you want in the new binary field—word processor documents, sound, bitmapped graphics, multimedia data—and then manipulate it under program control. Each can hold up to 256Mb of data per field—up to 4 gigabytes per table! There's no easier way to manage large applications.



◀ With the new Applications Workshop, you can build complete applications that include pull-down menus, mouse support, transparent multiuser edit sessions and more. Best of all, it's simple!

Efficient memory management

Paradox 4.0 gives you the best way to manage memory. VROOMM™ with Turbo Drive™ provides more available memory and more efficient memory utilization. So Paradox 4.0 runs on any 286 PC or above. In addition, Paradox 4.0 can run as a DOS application under the Microsoft® Windows operating environment, thanks to complete DPMI support.

DEMAND

The most award-winning database

Since its introduction, Paradox has won more awards for technical excellence and customer satisfaction than *any* other database. Awards from every major computer magazine and periodical from around the world. In fact, in a recent survey by *ComputerWorld*, Information Systems professionals ranked Paradox as having the best technology, best documentation, best service and support and best price performance. All of which have made Paradox the favorite of users and developers alike.



May 28, 1991
Paradox, Version 3.5



March 1992
Paradox 3.5



BEST TECHNOLOGY
BEST SERVICE/SUPPORT
BEST DOCUMENTATION
BEST PRICE/PERFORMANCE



PARADOX SQL LINK
★★★★
Rated # 1
Vol. 8, Number 2
February 1991



May 1991
Paradox 3.5



PARADOX 4.0
★★★★
Rated # 1
Vol. 9, Number 2
May 1992

Faster network performance

Paradox 4.0 is the fastest multiuser network PC database ever. And it's network-ready right out of the box. Multiple users can read, write and modify data simultaneously. You get all this, plus new automatic group lock security that allows multiple users to share data flexibly, providing dramatically increased performance. Just another reason Paradox 4.0 is the best investment for your business.

Transparent access to SQL data

With Paradox SQL Link (sold separately), you can seamlessly access remote SQL data. You can then work with this data using standard Paradox features such as Query By Example. Paradox does all the translation for you.

Paradox SQL Link completely shields you from the intricacies of PC and database server communications. When you specify an SQL table operation, Paradox SQL Link automatically selects the correct communications protocol, opens up

Paradox Developer's Corner

Powerful, procedural language

The Paradox Application Language (PAL™) lets you create sophisticated Paradox applications quickly. PAL procedures allow for private and global variables, array passing and variable scoping. Paradox 4.0 includes more than 90 new commands and functions.

Powerful UI controls

Easily construct your applications with a robust look and feel using the built-in UI controls: non-modal pull-down menus, dialog boxes (with push buttons, check boxes, radio buttons, pick lists, type-in lines and more), pop-up menus, mouse support and multiple overlapping windows.

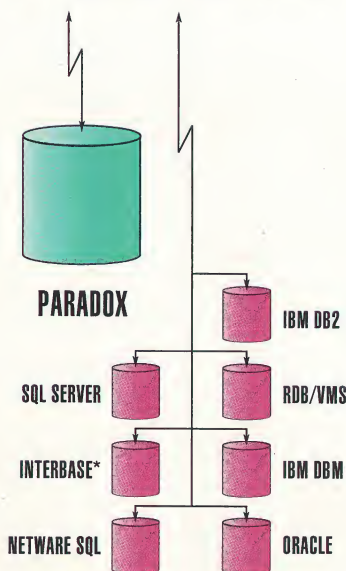
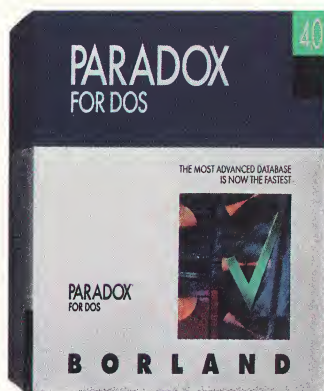
Event-driven extensions

GetEvent() passes keyboard, mouse and/or system events into your procedures for dispatching. Use dynamic arrays to pass dynamically created data structures to procedures. This greatly increases the modularity and reusability of your code.

Leverage Paradox behavior

Build on Paradox's multiuser support for automatic locking, multi-table forms and referential integrity. Define special error-handling procedures to trap and process error conditions, giving you complete flexibility over users' interaction with your custom application.

BORLAND



*Paradox SQL Link supports more industry-standard database servers than any other PC database available. (*And the InterBase SQL connection will be available soon.)*

a communication link, relays statements to the database server and presents the results of your query.

By using Paradox SQL Link, you can now enjoy the benefits of SQL databases without the difficulty of mastering the SQL programming language. In addition, Paradox SQL Link operations follow database server security restrictions.

Borland—the database leader

Borland is the acknowledged leader in PC relational databases. More users and developers trust their data to Borland products than any other company. And an integral part of that trust is Paradox.

Paradox 4.0's power to create and manage sophisticated applications, maintain data integrity, handle large quantities of data, perform complex database operations and connect to corporate data is critical to the success of a database management system today. No other PC database meets this challenge like Paradox 4.0—the most advanced database. Best of all, with Paradox 4.0's 60-day, money-back

guarantee, you can order risk-free today. So demand the best. Demand Paradox!



**To upgrade or
order, see your
dealer or call
1-800-331-0877,
ext. 5869 today!**

**Canadian customers call
1-800-461-3327.**

BORLAND

Software Craftsmanship

Circle 94 on Inquiry Card (RESELLERS: 95).

BYTE

EDITOR IN CHIEF
Dennis Allen

EXECUTIVE EDITORS
New York: Rich Malloy
Peterborough: Rich Friedman

MANAGING EDITOR
Anne Fischer Lent

ASSISTANT MANAGING EDITOR
Lauren A. Stickler

NEWS
Peterborough:
Senior Editor: Dan Muse
News Editors, What's New: Martha Hicks, Carol Swartz
Microbytes: David L. Andrews
News Assistant: June Sheldon
San Francisco/West Coast:
Bureau Chief: Andrew Reinhardt
Senior Editor: Tom Halfhill
News Editor: Patrick Waurzyniak
Editorial Assistant: Barbara J. Caravello
Los Angeles:
Senior Editor: Gene Smarte
New York:
News Editor: Ed Perratore
UK/Europe:
Bureau Chief: Andrew Redfern

BYTE LAB
Senior Editor & Director: Alan Joch
Technical Director: Rick Grehan
Technical Editors:
Stephen Apiki: systems, networking
D. Barker: applications software
Stanford Diehl: graphics software, add-ins, peripherals
Tom Yager: multimedia, Unix, operating systems, software development
Testing Editors/Engineers: Raymond GA Côté, Howard Eglowstein, Ben Smith, Stanley Wszola
Lab Assistant: Selinda Chiquoine

STATE OF THE ART/FEATURES
Senior Editor: Michael Nadeau
Technical Editors: Janet J. Barron, Robert M. Ryan

SENIOR TECHNICAL EDITORS
At Large: Tom Thompson, Jon Udell
Columns: Rob Mitchell

ASSOCIATE TECHNICAL EDITORS
Ellen Bingham, Susan Colwell, Jeff Edmonds, Tom Keven, Cathy Kingery, Margaret A. Richard, Warren Williamson

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Hugh Kenner, Barry Nance

CONSULTING EDITORS
Roger C. Alford, Jonathan Amsterdam, Nicholas Baran, Don Crabb, David Fiedler, Laurence H. Loeb, Trevor Marshall, Dick Pountain, Wayne Rash Jr., Kenneth M. Sheldon, Jane Morrill Tazelaar, Ellen Ullman, Peter Wayner

EDITORIAL ASSISTANTS
Office Manager: Peggy Dunham
Assistants: Linda C. Ryan, Janet A. Young

DESIGN
Director: Nancy Rice
Associate Director: Joseph A. Gallagher
Designers: Jan Muller, Rebecca Magill

PRODUCTION AND FINANCE
Director: Claudia Flowers

PRODUCTION
Director: David M. Cohen
Production Manager: David R. Anderson
Senior Editorial Production Coordinator: Virginia Reardon
Editorial Production Coordinator: Barbara Busenbark
Systems Manager: Sherry Fiske
Applications Manager: Donna Sweeney
Typesetter: Christa Patterson
Creative Services Manager: Susan Kingsbury
Production Artist: Lillian J. Wise
Advertising Services Manager: Linda Fluhr
Senior Advertising Services Representative: Lyda Clark
Advertising Services Representatives: Dale J. Christensen, Karen Cilley, Rod Holden
Advertising Services Assistant: Roxanne Hollenbeck
Quality Control Manager: Wai-Chiu Li
Operations Assistant: Lisa Jo Steiner

FINANCE
Business Manager: Kenneth A. King
Financial Analyst: Kathleen Degulise
Assistants: Marilyn Parker, Diane Henry, JoAnn Walter, Jaime Huber, Agnes Perry

MARKETING AND PLANNING
Director: L. Bradley Browne
Administrative Assistant: Carol Cochran
Marketing Communications Manager: Pamela Petrakos
Public Relations Manager: Dawn Matthews
Marketing Art Director: Stephanie Warnesky
Associate Art Director: Sharon Price
Market Research Manager: Julie Perron
Copyrights Manager: Faith Kluntz
Reader Service: Cynthia Sands
Marketing Assistant: Carol Sanchioni

CIRCULATION
Director: Glyn Standen
Subscriptions Manager: Paul Ruess
Assistant Manager: Pam Wilder
Subscriptions Assistant: Christine Tourgee
Newsstand Manager: Vicki Weston
Assistant Manager: Karen Desroches
Back Issues: Louise Menegus
Direct Accounts Coordinator: Ellen Dunbar

PUBLISHER
Ronald W. Evans

Publisher's Assistant: Donna Nordlund

ADVERTISING SALES
National Sales Manager:
Jennifer L. Bartel (214) 701-8496

NEW ENGLAND
Michael Lamattina (617) 860-6344

EAST COAST
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368

SOUTHEAST
Mary Ann Goulding (404) 843-4782

MIDWEST
Kurt Kelley (312) 616-3328

SOUTHWEST, ROCKY MOUNTAIN
Jennifer Walker (214) 701-8496

SOUTH PACIFIC
Beth Dudas (714) 753-8140
Alan El Faye (213) 480-5243

NORTH PACIFIC
Bill McAfee (408) 879-0381
Roy J. Kops (415) 954-9728

INSIDE ADVERTISING SALES
Director: Liz Coyman (603) 924-2518
Assistants: Susan Monkton, Vivian Bernier

NATIONAL ADVERTISING SALES
Ed Ware (603) 924-2664
Patricia Payne (603) 924-2654
Jon Sawyer (603) 924-2665
Barry Echavarria (603) 924-2574
Joseph Mabe (603) 924-2662

THE BUYER'S MART (1x2)
Margot Gnade (603) 924-2666

HARDWARE/SOFTWARE SHOWCASE
Ellen Perham (603) 924-2598
Mark Stone (603) 924-2695

REGIONAL ADVERTISING SECTIONS
Brian Higgins (603) 924-2651
Barry Echavarria (603) 924-2574
Larry Levine (603) 924-2637

BYTE DECK
Brad Dixon (603) 924-2596

EURO-DECK
James Bail (603) 924-2533

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 367.

PERSONNEL
Human Resources Administrator:
Patricia Burke
Assistant: Fran Wozniak
Receptionist: Beverly Goss

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints, kudos, and submissions.

MAIN OFFICE: One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.

San Francisco: 425 Battery St., San Francisco, CA 94111, (415) 954-9718.

Los Angeles: 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.

New York: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.

UK/EUROPE: Wimbledon Bridge House, One Hartfield Rd., Wimbledon, London SW19 3RU, England, 011-44-81-543-1234.

ELECTRONIC MAIL: On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX for easy access.

MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own name.

OTHERS: Many editors also are reachable through uunet, AppleLink, CompuServe, and numerous other services.

U.S. fax: Editorial: (603) 924-2550

Advertising: (603) 924-7507

U.K. fax: 011-44-81-540-3833

SUBMISSIONS

Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.

Vendors: We welcome news of your new products; please call the News department or the BYTE Lab at the earliest possible date. We cannot be responsible for unsolicited product samples.


SUBSCRIPTION CUSTOMER SERVICE

Inside U.S. (800) 232-BYTE; outside U.S. (609) 426-7676. For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are \$29.95 for one year, \$54.95 for two years, and \$74.95 for three years in the U.S. and its possessions. In Canada and Mexico, \$34.95 for one year, \$64.95 for two years, \$87.95 for three years. In Europe, £29 (U.S. \$50) for fast surface delivery, £41 (U.S. \$70) for air delivery. Non-European countries U.S. \$50 for surface mail, or U.S. \$75 for air mail. Single copy price is \$3.50 in the U.S. and its possessions, \$4.50 in Canada. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue.

PHOTOCOPY PERMISSION:

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 27 Congress St., Salem, MA 01970, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 27 Congress St., Salem, MA 01970. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, Copyrights Manager, 603-924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

Copyright © 1992 by McGraw-Hill, Inc. All rights reserved. BYTE and BITE are registered trademarks of McGraw-Hill, Inc. Trademark registered in the United States Patent and Trademark Office.

 Member
Audit Bureau of Circulation

Founder: James H. McGraw (1860-1948).
Chairman, President and Chief Executive Officer: Joseph L. Dionne, Executive Vice President, General Counsel and Secretary: Robert N. Landes, Executive Vice President—Operations:

BIX INTERACTIVE ON-LINE SERVICE

DIRECTOR OF COMPUTER-RELATED SERVICES
Stephen M. Laliberte

EXCHANGE EDITORS
Amiga Exchange: Joanne Dow
Entertainment and Leisure Exchange: Rich Taylor
IBM Exchange: Barry Nance
Programmers Exchange: Bill Nicholls
Professionals Exchange: David Reed
Tojerry Exchange: Jerry Pournelle
Writers Exchange: Wayne Rash Jr.

SENIOR EDITOR, ON-LINE SERVICES
Anthony J. Lockwood

MEMBER SERVICES MANAGER
Kevin Plankey

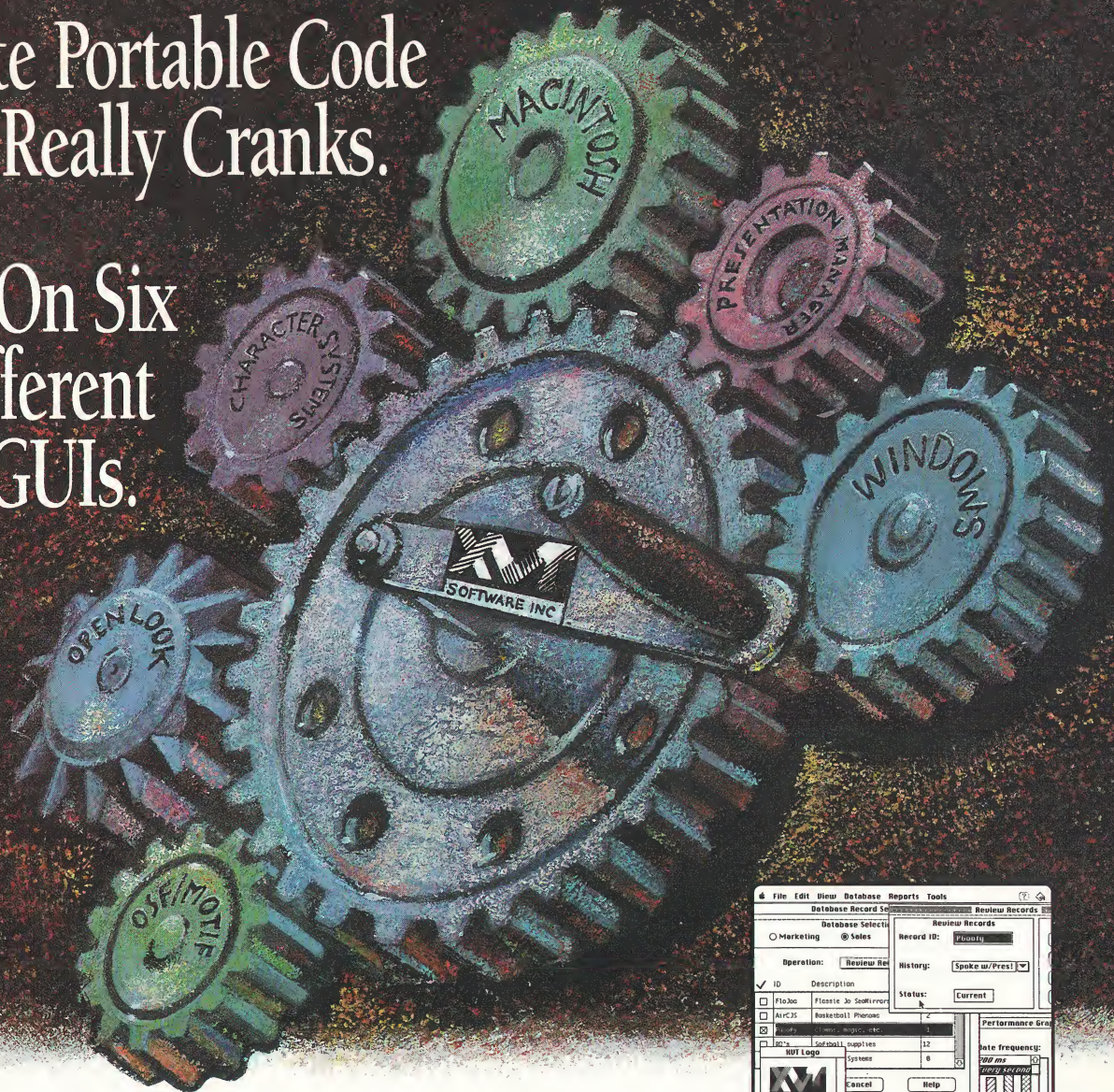
BIX, owned and operated by General Videotex Corporation, is a worldwide, low-cost, on-line information service featuring industry news, downloadable software, powerful electronic mail, previews of upcoming BYTE articles, the full text of published issues of BYTE, and source and/or executable code for BYTE benchmarks and noncommercial software mentioned in feature articles. BIX also offers unmatched "conferences" on virtually every computer-related topic imaginable, where you can share information with thousands of other computer pros. To subscribe via modem, set your communications software to full duplex, 7 bits, even parity, 1 stop bit, and then call (800) 225-4129; in MA, call (617) 861-9767. International, call NU1310690157800. Then hit the Enter/Return key and enter "BIX" when asked to log in; then enter "BIX.VILLE" when asked for a name. For current fees and more information, call (800) 695-4775 or (617) 354-4137 on voice phone; fax: (617) 491-6642.

OFFICERS OF MCGRAW-HILL, INC.:

Chairman, President and Chief Executive Officer: Joseph L. Dionne, Executive Vice President, General Counsel and Secretary: Robert N. Landes, Executive Vice President—Operations: Harold W. McGraw III, Senior Vice President, Treasury Operations: Frank D. Penglase.

Write Portable Code That Really Cranks.

On Six Different GUIs.



XVT's Portability Toolkit™ is a powerful C development environment that allows you to build a single application, then re-compile to every major GUI without rewriting code. XVT solutions also include an interactive design tool and class library for C++ developers.

- Supports Macintosh, Microsoft Windows (NT in development), OS/2 Presentation Manager, OPEN LOOK, OSF/Motif, and Character Systems
- Native look-and-feel to all target GUIs
- Portability to 26 hardware systems
- Access to the complete functionality of every windowing system
- Easier to use than native development toolkits
- Minimal size and performance overhead
- Shorter development cycles
- No royalties or runtime fees
- Clear documentation and responsive technical support

Now in its third generation, XVT is recognized as the industry leader in portable GUI development solutions and is the base document for the emerging IEEE standard. It is used by world-class software developers like •Novell •HP •AT&T •Digital •Lockheed •Kodak •Grammatik/Reference Software, because it allows them to take their applications to the widest market, quickly and cost-effectively.

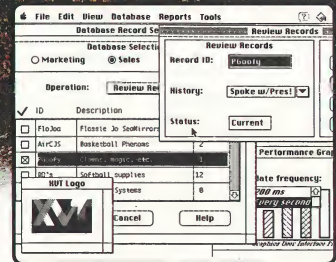
Don't write another line of code without gearing up to develop your application simultaneously for all GUIs. Call for technical materials and a demo.



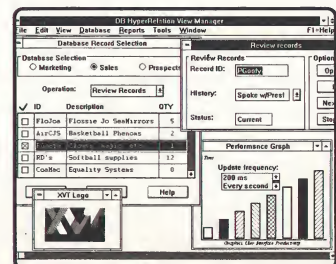
The portable GUI development solution.

1-800-678-7988

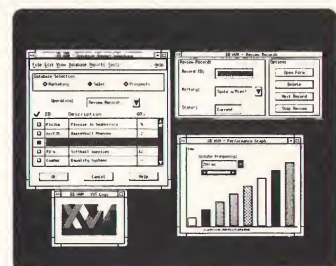
XVT Software Inc. Box 18750 Boulder CO 80308



▲ Macintosh



▲ Microsoft Windows



▲ OSF/Motif

Shown above are three of the six GUIs supported by XVT.

XVT is a trademark of XVT Software Inc. Other product and company names are trademarks or registered trademarks of their respective holders.

WE'RE ONLINE. AND IN LINE WITH YOUR OBJECTIVES.

BUSINESS WEEK

AEROSPACE DAILY

AIRPORTS

AVIATION DAILY

AVIATION WEEK &
SPACE TECHNOLOGY

BIOTECHNOLOGY NEWSWATCH

BYTE

CHEMICAL ENGINEERING

CLEAN-COAL/SYNFUELS LETTER

COAL WEEK

DATA COMMUNICATIONS

ELECTRIC UTILITY WEEK

ENGINEERING NEWS-RECORD

HAZARDOUS WASTE BUSINESS

INDEPENDENT POWER REPORT

INDUSTRIAL ENERGY BULLETIN

INSIDE ENERGY/
WITH FEDERAL LANDS

INSIDE F.E.R.C.

INSIDE N.R.C.

INTEGRATED WASTE MANAGEMENT

LAN TIMES

NUCLEONICS WEEK

POSTGRADUATE MEDICINE

PLATT'S INTERNATIONAL
PETROCHEMICAL REPORT

PLATT'S OILGRAM NEWS

PLATT'S OILGRAM PRICE REPORT

S&P'S EMERGING & SPECIAL
SITUATIONS

S&P'S REVIEW OF BANKING
& FINANCIAL SERVICES

S&P'S REVIEW OF SECURITIES
& COMMODITIES REGULATION

SECURITIES WEEK

TECH TRANSFER REPORT

UTILITY ENVIRONMENT REPORT

THE WEEKLY OF BUSINESS AVIATION

UNIXWORLD

AND MORE...

When you need business information, why not get the total story, instantly! Word for word. The McGraw-Hill Publications Online database gives you just that. Unedited, full-text retrieval (except graphics) of articles exactly as they are published in McGraw-Hill magazines and newsletters.

Now you can get information on companies, people and products on any topic — pertaining to one particular industry, or search the entire McGraw-Hill library (over 35 leading publications online) for diverse editorial perspectives. Only McGraw-Hill, the world's foremost business information publisher, can deliver it all so completely — immediately! McGraw-Hill unabridged.

Access an entire universe of business information. Go online with our line. McGraw-Hill Publications OnLine. For more information, including our latest list of publications, contact Andrea Broadbent at (609) 426-5523. Or fax this coupon to (609) 426-7352.

Or send it to the address below.

Available through Dialog®, Dow Jones News/Retrieval®, NewsNet® and Nexis®.

McGRAW-HILL PUBLICATIONS ONLINE



Princeton-Hightstown Road
Hightstown, NJ 08520 U.S.A.

Please send me the complete 1992 list of your publications online.

BY

Name _____

Title _____

Company _____

Address _____

City _____

State _____

Zip/Postal Code _____

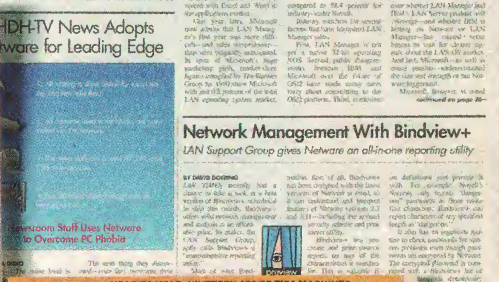
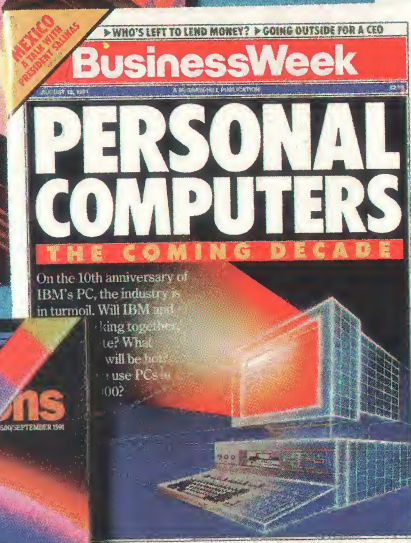
Country _____

Tel. _____

GO ON LINE WITH OUR LINE.

Your network buy for today's business technology market.

McGraw-Hill TechNet



McGraw-Hill Magazines. Your Best Business Partners.

- 4- Architectural Record ■ 7- A/C Flyer, Aviation Week & Space Technology, AW & ST China Quarterly, AW & ST USSR, Business & Commercial Aviation, World Aviation Directory and Buyer's Guide ■ 20- Business Week, Business Week China, Business Week Hungary, Business Week International, Business Week USSR ■ 28- Chemical Engineering ■ 32C- BYTE, Data Communications, Data Communications International, LAN Times, UnixWorld ■ 39-Electrical World ■ 41- ENR, Construction News Publishing Network (11 magazines, 4 newspapers) ■ 46- Global Finance ■ H6- The Physician & Sportsmedicine, Postgraduate Medicine ■ 114- Modern Plastics, Modern Plastics International ■ 117- Power, Power International



LETTERS

OS/2 in Review

I would dispute Jon Udell's claims of problems with IBM's OS/2 2.0 in "OS/2 2.0: A Mixed Blessing" (August). The WPS (Workplace Shell) is a well-designed and well-thought-out replacement for the Presentation Manager. The object-oriented system designed for WPS is far superior to the Windows Program Manager and File Manager, and once you get used to it, it is easy to use.

I have had few problems with WPS crashing. When it has crashed, OS/2 has taken care of the situation by killing it and restoring it immediately. WPS seems to run quite fast with my 40-MHz 386, and I'm happy with its speed.

I deleted Windows and never looked back. Buying OS/2 2.0 is the best decision I've made since buying a 386 system. I think a lot of people will agree, especially after the 32-bit graphics engine and Windows 3.1 enhancements become available this fall.

Timothy D. Jasionowski
Fairfax, VA

Jon Udell's review of OS/2 2.0 missed some important points. To have a stable OS/2 setup, you really need 8 MB of RAM and 40 MB of disk space. Contrast this to IBM's stated minimum of 4 MB of RAM and 30 MB of disk space. Udell would have been better off spending \$50 to \$60 on 2 MB of RAM for his PS/2 and leaving the HPFS (High Performance File System) cache at 256 KB.

Regarding the disk search test, Udell made no mention of the two-to-three-times speed improvement, for both OS/2 and DOS/Windows programs, that occurs when using the HPFS. Since VDMs can access HPFS partitions under OS/2, there is no reason not to use HPFS.

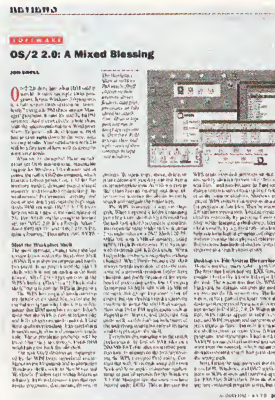
I beat up heavily on the WPS and have rarely seen it crash. A couple of times I have seen the WPS crash and then restart itself, bringing up all my applications as if nothing had happened. Let's see DOS/Windows try that.

All in all, OS/2 2.0, with all its faults, is the most stable operating system I have ever used. My PC has run many weeks at a time without a reboot. Looking back on my DOS/Windows days, I remember having to reboot often.

John Morris
Sparks, NV

I've used every version of OS/2 since 1.0. For my money, the best one yet was 1.3. And yes, let's be quite clear, the quality of that product is thanks to IBM, not Microsoft. I'd like to be able to say that OS/2 2.0 comes up to the same standard. But along with the WPS, 32-bitness, multiple DOS boxes, and Windows support came problems with ease of use, integration, performance, and stability.

If you follow the OS/2 conferences on BIX, CompuServe, and the Internet, you must have noticed that I'm



not alone in my indictment of the WPS. Most power users come to terms with it (myself included), but only after a struggle that IBM shouldn't have required of everyone. The WPS, several readers have reminded me, can rise phoenixlike from its own ashes. Indeed it can, but that's faint praise.

For the record, I tested the shipping version of 2.0 on two machines: a 16-MB Systempro 486/33 (using a file allocation table) and a 6-MB PS/2 Model 70 (using HPFS). File-search performance lagged behind that of Windows 3.1 on both machines by an order of magnitude. A sta-

bler, faster, more intuitive WPS has to be a top priority for the forthcoming point release of 2.0.

Like Unix, OS/2 puts DOS/Windows to shame in many respects. Yet, like Unix, OS/2 hasn't been an easy migration choice for DOS/Windows users. I'd love to be able to install OS/2 on every PC hooked to the network I manage and have those machines keep doing everything they do now—only faster and more reliably. Unfortunately, 2.0 isn't the OS/2 that can pull that stunt off. I'd love to be shown one that can.—Jon Udell

Not for Wimps

For years, I've been reading articles that criticize the weight of laptop and, now, notebook computers. At first the reviewers complained unless a laptop was under 12 pounds, then 10 pounds, then 8 pounds. Now they say a 7-pound notebook is too heavy and advise something in the 5-pound range if you'll be lugging it to the airport.

Who are these wimps? I'm 44 years old, weigh 135 pounds, and carry my 17-pound bag of golf clubs around 18 holes at least twice a week. And these reviewers can't make it to the airplane with 7 pounds and a carry-on bag?

These yuppies. None of your reviewers play golf? I knew it—they ride in a cart.

Ron Crisona
address unknown

The PC Gets Personal

Thank you for your generous comments about the Gateway 2000 Handbook in your July cover story, "The PC Gets More Personal." IQV Corp. designed this product and had it manufactured in Japan. Gateway private-labels it from us. We believe the day is fast approaching when people will be unwilling to carry 6- to 7-pound notebook computers on business trips. Some visionaries are even convinced that weight is so important to travelers that subnotebooks will eventually replace notebooks, just as notebooks replaced laptops.

Thomas F. Dornback
President
IQV Corp.
Wheeling, IL

Thanks for the compliment. Let's hope those visionaries don't meet Ron Crisona on the golf course.—Eds.

WE WANT TO HEAR FROM YOU. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, send BIXmail c/o "editors," or send Internet Mail to letters@bytepb.byte.com. Letters may be edited.

We slash interface development time across DOS, UNIX, POSIX, VMS... (and we can prove it!)

C-Programmers:
See for yourself how
Vermont Views™
can help you create
powerful user
interfaces—whatever
your environment!

If you want to create sophisticated user interfaces—and save *tremendous* time and effort doing it—Vermont Views is exactly what you need.

Vermont Views isn't just a common interface package. It's a deep, flexible, menu-driven screen designer supported by a C library of over 580 functions. It lets you create the ultimate user interfaces for

complex database applications—in a fraction of the time it would take to code them yourself!

With Vermont Views, you create screens *interactively*. Designing is fast, and creative. And changes—both tiny adjustments and huge reworks—are incredibly easy.

Pull-down menus, window-based data-entry forms with tickertape or memo fields, scrollable form regions, choice lists, context-sensitive help... All these interface objects (and more) are immediately accessible. And with Vermont Views, even terminal-based applications can have the elegant features usually found only on micros.

© Copyright 1991
Vermont Creative Software

**Fast prototypes,
faster applications.**

With most systems, you have to throw away your prototypes when coding begins. But with Vermont Views, *prototypes become the actual applications!*

Menus, data-entry forms, and all screen features are usable in the final applications without change. So not only do you avoid creating code from scratch once, you don't have to do it twice!

**It's the
universal solution.**

Vermont Views operates completely independent of hardware, operating system, and database.

Any interface you create can be ported easily among DOS,

UNIX, POSIX, and VMS.

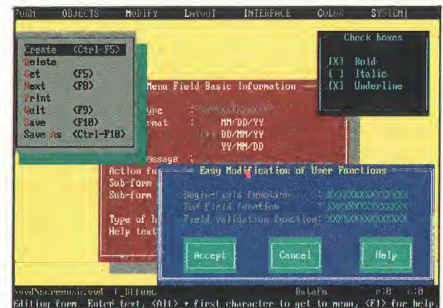
You can use Vermont Views with any database that has a C-language interface (including Oracle, Informix, db_Vista, and C-Tree). You can run it on PCs, DEC, NCR, HP, AT&T, and other systems. You don't have to pay runtime fees or royalties. And full library source is available, too.

What's more, your DOS applications can have full mouse control, and work in



**Vermont
Creative
Software**

Pinnacle Meadows
Richford, VT 05476 USA
Phone: (802) 848-7731
FAX: (802) 848-3502

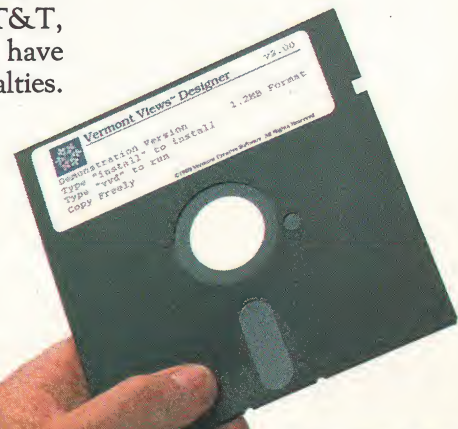


graphics as well as text modes!

Don't take our word for it—put Vermont Views to the test. Call or fax now for your personal, free demonstration kit. Or order Vermont Views with our 60-day, money-back guarantee.

Either way, you'll see immediately that Vermont Views is a cut above the rest.

**Call for your
FREE demo kit!
800-848-1248**



**(Please Mention
"Offer 349")**

In "The PC Gets More Personal" the authors state that there is presently no affordable wireless communication technology for the consumer. They mention cellular telephones and packet radio but not second-generation cordless communications (CT2), also known as Telepoint.

This technology, in common use in Europe, is known as "Bi Bop" in France, "Birdie" in Germany, and "Rabbit" in the U.K. It's about to be implemented in Canada in an enhanced form called CT2Plus. This digital technology operates much like a cordless phone (unlike cellular, it does not support roaming). The difference is that the base station can be a public base station connected to a PBX. The handsets are relatively cheap—less than \$300—and support about 10 hours of continuous talk time.

While cordless technology doesn't provide true mobile communications in the same way as cellular, it does offer affordable wireless communications in a large number of environments. Since the infrastructure requirements are less than for cellular or packet radio, the implementation of the networks is likely to occur more quickly.

Chris Shepherd
Beeston, U.K.

Unix for Nothing

In response to Ben Smith's First Impression of Mark Williams Co.'s low-cost Unix clone, Coherent ("Coherent Grows Up," August), I'd like to bring to your attention Linux, a free Unix clone written by Linus Torvalds of Finland, with help from hundreds of programmers from all over the world. Linux is a 386-specific, mostly Posix-compliant, SYSV-like Unix clone. It rates favorably in benchmark testing against commercial versions of Unix.

One of the few reservations Smith had about Coherent was its lack of X Window System support. I run X on my Linux machine daily.

Due to the widely varying backgrounds from which Linux's contributors come, the system is blessed with very good hardware support: SCSI, several brands of Super VGA cards, nonstandard serial configurations, and many brands of motherboards. Peripheral drivers are well represented, too. I wrote most of the Logitech bus mouse driver and am working on a CD-ROM driver.

Linux lacks kernel support for TCP/IP. However, a group of programmers is working on that.

Linux is available via anonymous FTP from tsx-11.mit.edu:/pub/linux (U.S.) or nic.funet.fi:/pub/os/linux (Europe). The news group is comp.os.linux; send E-mail to linux-activists-request@niksula.hut.fi to join the mailing list.

David Giller
Los Angeles, CA

MacGuffin Rebuff

Jim Manzi's Stop Bit, "The Productivity MacGuffin" (August), raises interesting questions, but I find his prescription for more LAN hardware unconvincing. A failure to achieve increased productivity through computerization may have little to do with hardware and software choices and does not necessarily say anything about the value of computerization. It more likely reflects inadequacies of management style and practice and the adoption of

computerization strategies aimed mainly at bolstering the status quo.

A reasonable alternative is to take a hard look at the assumptions underlying management practice and to establish productivity-related goals regarding such things as manager/worker ratios. Then one is in a position to decide how computers might contribute to solutions.

Mike Connealy
Las Cruces, NM

It is curious to see Jim Manzi concerning himself with the effect of computers on productivity when his company is busy litigating to try and prevent software developers from using commands and keystrokes with which users are already familiar. If he succeeds—and it appears that he has—applications will no longer be able to use the same keystrokes or menus as competing products, and user productivity will inevitably suffer. If Manzi really wants to increase the productivity of white-collar workers, the best thing he can do is get Lotus to drop its ridiculous lawsuits against companies such as Borland.

Mathew
Cambridge, U.K.

A20 Issues

Mark J. Minasi's "Exorcising the A20 Poltergeist" (August) was very educational. I was interested to learn that the A20 handler chip also processes the keyboard. However, the article had one minor error. The 386SX and 386SL processors have 32 address lines, not 24. Otherwise, how could a 386SX go to 386 extended mode in Windows? This requires the CPU to go to virtual mode, which requires access to the full 4-GB address space of the 386/486 family.

The distinction Minasi was thinking of is the number of data lines in the external data bus. The 286, 386SX, and 386SL all have 16-bit external data buses, while the 386DX and 486 have 32-bit buses. Although this error was not significant in the context of the column, I thought readers would be interested in the distinction.

In my opinion, IBM should have left out the A20 gate and written an A20 software handler back in 1983.

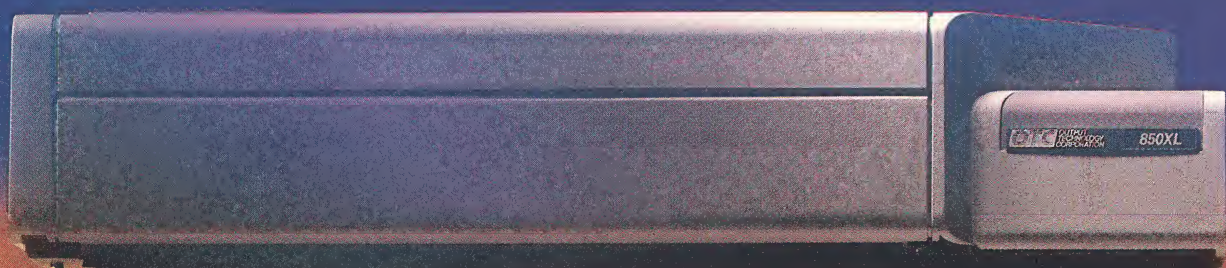
Charles Bretana Jr.
Apple Valley, CA

Real Time Goes Amiga

When I read "Real Time Goes Home" (August), I thought Ken Kaplan was describing things to come. I was pleasantly surprised to learn that CD-I was fulfilling the real-time promise. However, there is another entry in the home information appliance market that warrants mention: the CDTV by Commodore Business Machines. CDTV is an Amiga computer with a battery of infrared I/O devices, a CD-ROM drive, and a personal RAM card slot. It is capable of all the actions described in the article.

I hope Commodore will give us the opportunity to make it happen. At a street price of about \$700, the CDTV doesn't quite fit Kaplan's \$200 scenario, but we all know what time does in these markets. ■

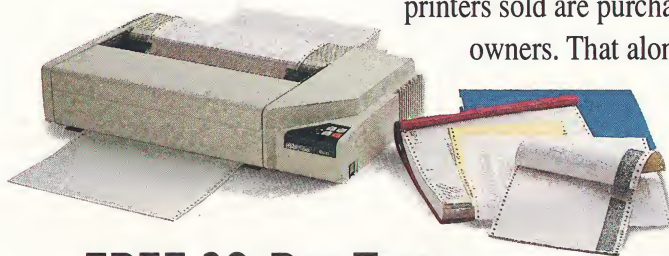
Gordon Cunningham
Sebago Lake, ME



850 CPS & TOUGH AS NAILS!

850 CPS. That's right – 850 characters-per-second!

TOUGH AS NAILS. Why take a chance? Thousands of owners use the 850XL printer from 2 to 18 hours per day. It just keeps on printing, day-in, day-out! And, over 50% of all 850XL printers sold are purchased by existing owners. That alone tells the



story for this American-made printer.

FREE 30-DAY TRIAL. We offer a free, 30-day trial to any qualified buyer. No strings attached. What other manufacturer believes this strongly in their product?

Call Us Today! **(800) 468-8788**

GSA Pricing: 800-633-9433

GSA Contract #GS00K-91-AGS-5268

OTC **OUTPUT
TECHNOLOGY
CORPORATION**

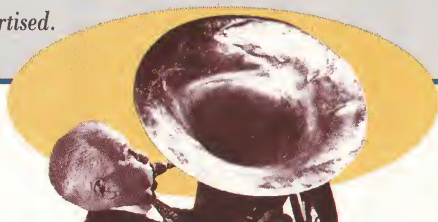
Should you need service, there are over 400 service locations nationwide to serve you.

2310 N. Fancher Road, Spokane, WA 99212-1381

Compudyne™. Latest Technology. Highest

Compudyne is the PC manufacturing and direct marketing arm of CompUSA™, the Computer SuperStore (NASDAQ symbol; CUSA)—inventors of big volume, deep discounting PC retailing, and the largest chain of computer super stores in the country. Compudyne manufactures top quality, fully-supported computers as available from only the largest PC manufacturers at prices typically found only at garage shop clone houses.

Result? We're already one of the largest direct PC companies in the country and guarantee that our prices are the lowest of any currently advertised.



We are to PC Prices what "Rhapsody for Subsonic Tubas" was for music. The notes were so low, no one could hear them. Requests for encore performances were subsequently low.



We are to notebooks what Griselda of Skyland was to Pomeranians; the lightest.



Notebooks

Feast your eyes on "one of the best notebook values around" (Mobile Office 7/92), snugly packed into a slim, trim, 5.5 lb package (including battery). All include these nifty features:

- 11" x 8.5" x 1.6" (yes, only 1.6" thick!)
- Full 10", 64 grayscale brilliant VGA screen

- Internal 3 1/2" 1.44 MB floppy drive
- Built-in trackball saves carrying a mouse
- MS/DOS 5.0 and Microsoft® Windows 3.1 installed ready to run
- Polaris PackRat 4.0™ Personal Information Manager™
- External SVGA monitor and keyboard support

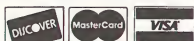
- Toshiba-compatible external expansion bus
- User-installable FAX modem and other options
- Full keyboard—dedicated 'page up/down', 'home' and 'end' keys
- Built-in serial (2) and parallel (1) ports
- FCC Class B certification



Notebook	CPU	RAM (MBs)	HD (MBs)	Battery Life (Hrs)	Price
386SXL/25	386SXL-25 MHz, Optional 80387SX	2 standard, 4 & 6 optional	80	3+	\$1,599 \$59/mo*
386SL/25	Intel 80386SL-25 MHz, 64 K CPU cache Advanced SL power mgmt, Optional 80387SX co-processor	as above	80	3+	\$1,799 \$67/mo*
486SX/25	Intel 80486SX-25 MHz, Built-in 8K CPU cache	4 standard, 8 & 20 optional	80	2.5+	\$1,999 \$74/mo*
486DX/33	Intel 80486DX-33 MHz, Built-in 8K CPU cache	as above	130	2.5+	\$2,899 \$107/mo*

ORDERING

- ▶ 1-800-932-COMP (2667)
- ▶ International callers dial: 1-214-702-0055
- ▶ 24 hour fax: 1-214-702-0300
- ▶ Corporate credit and volume terms available.



HOURS OF OPERATION

- ▶ 8am-7pm (CST) Mon.-Fri. and 9am-4pm (CST) Sat.

SERVICE & SUPPORT

- ▶ Toll-free technical support
- ▶ On-site service for desktops†† and overnight replacement for portables.
- ▶ Next-day shipping for most systems.

WARRANTIES

- ▶ 30-day, no questions asked, return policy.√
- ▶ 1 year limited warranty.



**DIAL
TO SAVE
DOLLARS**

1-800-932-COMP (2667)

††Within 100 miles of any Dow Jones Service Center. **Does not include Windows 3.1 or mouse. √ Must be returned "as new" in original package.

Quality. Lowest Prices. Guaranteed.

Desktops

Order one of our pre-configured systems or custom-configure your own, choosing from a myriad of options. All systems include...

- Microsoft® Windows 3.1 and MS/DOS 5.0
- Microsoft compatible serial mouse
- 200 watt power supply
- 101 AT-style keyboards
- FCC Class B certification

- Built in serial (2), parallel (1) and game (1) ports
- Artisoft's LANtastic® LAN
- 8 i/o board slots
- U/L listing



Get Horizontal...

Our standard desktop systems feature aesthetic yet rugged plastic-over-steel construction with "one screw" assembly

for quick easy upgrades. They support 3 externally accessible 5.25" drive bays and 2 internal 3.5" units.

Get Vertical...

For those who prefer the aesthetics and footprint of a desktop tower or need the added drive capacity for file server applications, our mini tower offers an astonishing 6 drive capacity; 4 external plus 1 internal 5.25" and 1 internal 3.5" unit in a mere 8" x 16" desktop footprint for only \$100 more.

Options, Options, Options...

- Displays: Mono or color VGA; 1024 and 1280 interlaced or non-interlaced; 14" to 20"
- Hard Drives: 40; 80; 105; 120; 211; 483; 680 MBs or 1.2 GBs
- Internal CD-ROM (Inc. Groliers Encyclopedia, Toolworks, Reference Library and PC-SIG)
- Internal FAX/Modem: 9600 bps send/receive fax; 2400 bps modem; inc. WinFax and Quicklink Software.
- And many more!

PRICE Guarantee



If you can find a PC that meets or exceeds our equivalent specification, but is shipping at a lower advertised price, we'll match the price.



4/14/92
LANtastic
ver. 4.1



PC MAGAZINE
EDITORS' CHOICE
LANtastic
in all systems!

all NEW!



Desktop	CPU	RAM (MBs)	HD (MBs)	Floppy	Display	Price
386DX/33	Intel 80386DX-33 MHz	1 standard 32 max	40	1.2 or 1.44	16 bit SVGA card, 14" 640x480 VGA Color Monitor	\$849 \$32/mo*
386DX/33 or 486SX/25	Intel 80386DX-33 MHz or Intel 80486SX-25 MHz, w/built-in 8K CPU cache	2 standard 32 max	80	as above	as above	\$999 \$37/mo*
486SX/25	Intel 80486SX-25 MHz Built-in 8K CPU cache	as above	80	1.2 & 1.44	16 bit SVGA card, 14" 1024 x 768 SVGA Color Monitor	\$1,199 \$44/mo*
386DX/33 CACHE	Intel 80386DX-33 MHz 64K CPU cache	4 standard 32 max	120	as above	16 bit SVGA card & Hi-Color Support 14" 1024 x 768 SVGA, 28 Interlaced Color Monitor	\$1,399 \$52/mo*
486SX/33	Intel 80486SX-33 MHz 8K CPU cache	as above	120	as above	as above	\$1,499 \$56/mo*
486DX/33 CACHE	Intel 80486DX-33 MHz 128K CPU cache	as above	120	as above	16 bit SVGA card, 1MB Video RAM & Hi-Color Support, 14" 1024 x 768 SVGA Non-Interlaced Multisync Color Monitor	\$1,799 \$67/mo*
486DX/50 CACHE	Intel 80486DX-50 MHz 128K CPU cache, True 50 MHz CPU	as above	120	as above	as above	\$1,999 \$74/mo*
486DX/66 CACHE	Intel 80486DX2-66 MHz, 128K CPU cache New Double Clock CPU	8 standard 32 max	200	as above	16 bit SVGA, Superfast Windows, Accelerator card, 1MB RAM, 14" 1024 x 768 SVGA Non-Interlaced Multisync Color Monitor	\$2,499 \$93/mo*

COMPU DYNE

THE LOWEST OF THE LOW PRICES. GUARANTEED.

Prices and specifications subject to change without notice. CompuDyne Direct, 15151 A Surveyor, Addison TX 75244.

BTE 1121

You can also buy these neat products at the same prices exclusively at **COMPUSA**.



NEWS

MICROBYTES

IBM Boca Raton Readies OS/2 Enhancements

BOCA RATON, FL—Now that IBM has passed the 1 million sales mark for OS/2 2.0, the company has its hands full keeping the bandwagon rolling at a sufficient clip to ward off the 16-bit Windows threat while attempting to preempt Microsoft's unreleased 32-bit Windows NT. By the end of the year, IBM expects to make several announcements in the areas of OS/2 multimedia, 32-bit graphics, Windows 3.1 support, and pen computing.

IBM's programmers have been improving OS/2 and fixing more than a hundred bugs found in the initial April release of version 2.0. By the end of next month, IBM expects to release a Service Pak that will fix the numerous bugs and enhance the operating system. The nominally priced Service Pak will offer faster DDE and Clipboard links between Windows and OS/2 Presentation Manager applications and between Windows applications when run from OS/2. A 32-bit graphics engine will provide developers with a flat-memory model that should cure problems encountered from the previous 16-bit engine's resource limits. Slowness attributed to 32-bit graphics calls being thunked, or converted, into 16-bit instructions should be alleviated, and seamless Super VGA and XGA support will allow for resizable windows where the original version 2.0 permitted full-screen windows only.

IBM will also provide video drivers for five major players in the video adapter market: Tseng Labs, ATI, Headland, Western Digital, and Trident. According to OS/2 senior programmer/manager Franz Walkow, the Tseng drivers will be included in the Service Pak; the others will follow early next year. A video device-driver kit for other vendors' boards should be available to developers this fall.

IBM will provide support for Microsoft's Windows 3.1 through an "installable feature." In this feature, the company will include most of Windows 3.1 but not games, the Windows macro recorder, the terminal emulator (OS/2 has its own terminal emulator), and certain applets. This feature will improve OS/2's support in several ways. DDE links will be supported across VDMs (virtual DOS machines), although OLE will work only within a single VDM. It will also add extensive online support for Windows, DOS, and OS/2. For example, instructions on creating a custom AUTOEXEC.BAT file for each VDM will be provided. (Previously, individual VDMs could not be customized beyond individual CONFIG.SYS files.) Windows applications will also run non-Windows DOS applications.

This year, IBM hopes to release OS/2 Pen Extensions for desktop pen devices (e.g., digitizing tablets) that are connected to desktop PCs. Support for pen-centric portable PCs like the original ThinkPad will arrive in the first quarter of 1993. Also slated is support for PCMCIA (Personal Computer Memory Card International Association) devices and the Intel-Microsoft Advanced Power Management specification.

Gordon Arbeitman, IBM's senior programmer for OS/2 Pen Extensions, said that the pen extensions will come bundled with an application called TeleSketch, which lets users share and collaboratively edit on a simulated blackboard across a LAN or a remote link. A second application called ImageMail, which lets you embed voice attachments in a pen program's document, began as an internal application and may or may not make it to market.

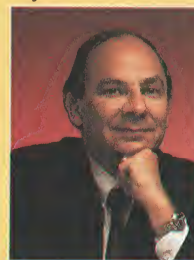
At the Fall Comdex, IBM plans to demonstrate beta versions of new UltiMotion software, a companion product to the shipping Multimedia Presentation Manager/2. UltiMotion, in combination with MMPM/2 and an IBM M-Audio or other adapters from Creative Labs and MediaVision, provides 8-bit audio, 320- by 240-pixel resolution, and full-motion color video at 24 frames per second. The program's algorithm can compress a 300-MB full-motion video file to a mere 6 MB.

—Ed Perratore

NANOBYTES

Now that LANs have become a reality in business computing, the move toward downsizing (or rightsizing) is gaining momentum, according to a recent **Datapro Information Services Group** (Delran, NJ) study. Of about 1000 respondents, 23 percent of MIS professionals plan to implement within the next 12 months a client-server structure in their organization, which is up from just 8 percent in 1991. One barrier to the successful implementation of a client-server solution, according to Datapro managing analyst Pam Paul, is that client-server applications and other software programs are not available yet for MISes. "There's a lot of pieces that are missing from this whole [client-server] puzzle," Paul said. One of those pieces is network system management, which is why Computer Associates is porting its CA-Unicenter for mainframes to NetWare. □

Softool's president **Leon Presser** says that another software piece



that will be crucial to the client-server puzzle is configuration maintenance and version-control. "As more companies down-

size, the change-control problem is multiplying," he said. "If you're going to downsize, change and configuration management is essential where it was not as essential when you were centralized," he said. When companies move to distributed network solutions, Presser explained, someone still needs to be responsible for managing the software that goes out to a population of users. □

Delivering the Power: WATCOM C9.0/386

Windows™ NT
Development Tools from WATCOM
Featuring powerful new GUI debugger
NOW available in Beta
Call 1-800-265-4555 to enroll

The Widest Range of 32-bit Intel x86 Platforms

32-bit DOS, 32-bit Windows, OS/2 2.0, AutoCAD ADS

The Industry's Leading Code Optimizer

Advanced global optimizer with new 486 optimizations

The Most Comprehensive Toolset

Debugger, profiler, protected-mode compiler and linker,
32-bit DOS extender with royalty-free run-time, licensed
components from Microsoft SDK, and more

The Best Value in 32-Bit Tools: \$895*

WATCOM C/386
32-Bit Optimizing Compiler and Tools

Unleash 32-bit Power!

WATCOM C9.0/386 lets you exploit the two key 32-bit performance benefits. The 32-bit flat memory model simplifies memory management and lets applications address beyond the 640K limit. Powerful 32-bit instruction processing delivers a significant speed advantage: typically at least a 2x speedup.

You Get:

- 100% ANSI and SAA compatible: C9.0/386 passes all Plum Hall Validation Suite tests
- Extensive Microsoft compatibility simplifies porting of 16-bit code
- Royalty-free run-time for 32-bit DOS, Windows and OS/2 apps
- Comprehensive toolset includes debugger, linker, profiler and more
- DOS extender support for Rational, Phar Lap and Ergo
- Run-time compatible with WATCOM FORTRAN 77/386

32-bit DOS support includes the DOS/4GW 32-bit DOS extender by Rational Systems with royalty-free runtime license

- ▶ Virtual Memory support up to 32Mb

32-bit Windows support enables development and debugging of true 32-bit GUI applications and DLL's.

- ▶ Includes licensed Microsoft SDK components

32-bit OS/2 2.0 support includes development for multiple target environments including OS/2 2.0, 32-bit DOS and 32-bit Windows

- ▶ Access to full OS/2 2.0 API including Presentation Manager
- ▶ Integrated with IBM Workframe/2 Environment

AutoCAD ADS and ADI Development: Everything you need to develop and debug ADS and ADI applications for AutoCAD Release 11

Novell's Network C for NLMSDK includes C/386

The Industry's Choice.

Autodesk, Robert Wenig, Manager, AutoCAD for Windows:

"At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, David Fulton, President: "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, Robert Carr, Vice President of Software: "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, John Soyryng, Director of OS/2 Software Developer Programs: "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, David Reed, Chief Scientist and Vice President, Pen-Based Applications: "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's. PenPoint."

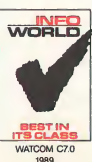
Novell, Nancy Woodward, V.P. and G.M., Development Products: "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."

WATCOM

1-800-265-4555

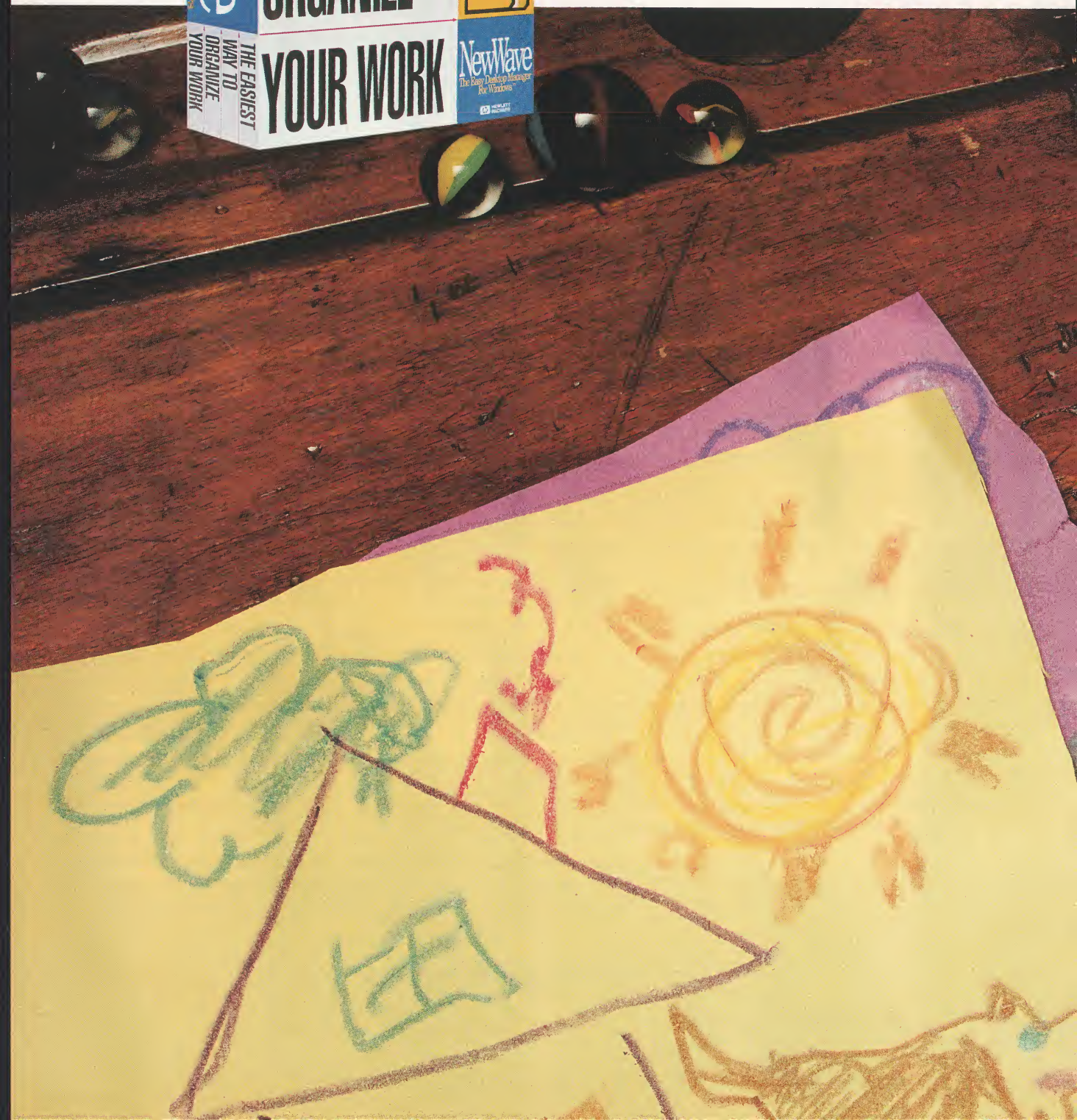
The Leader in 32-bit Development Tools

415 Phillip Street, Waterloo, Ontario, Canada. Telephone: (519) 886-3700, Fax: (519) 747-4971. *Price does not include freight and taxes where applicable. Authorized dealers may sell for less. WATCOM C and Lightning Device are trademarks of WATCOM Systems Inc. DOS/4G and DOS/16M are trademarks of Rational Systems Inc. Other trademarks are the properties of their respective owners. Copyright 1992 WATCOM Products Inc.






There Was A Time When A Clean, Uncluttered



ne When A Desktop Was tered Place For Your Stuff.



Everything was easy, remember? And now you have a modern PC running Microsoft Windows® and there's stuff all over the place. It's confusing even for computer wizards. Why can't a *computer* desktop be as simple and practical as a real one?

Well, it can be. But only with NewWave™, the easy desktop manager for Windows.

NewWave keeps all your important stuff together on your desktop or in a file drawer. Organized in neat, color coded folders with names up to 32 characters long.

Names like *Weekly Status Meeting Report* that tell you your spreadsheet, presentation, word processing—all the files for your weekly report are inside. With 32 character names of their own, so they're easy to find and understand, too.

You can click on any file and launch it without searching for the application that

created it. Or select a bunch of files, drag and drop them to the printer icon, and print them all automatically while you work on something else.

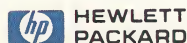
There's even a handful of really helpful icons like a waste basket that's a fast, safe way to delete files. And Agent macros that automate mouse clicks and keystrokes in Windows, DOS, or both.

That's why NewWave is the easiest way to organize your work. It keeps all your stuff in one place. Makes it easy to find, and easy to use. And even cleans up after you. Kind of reminds you of the good old days. Now doesn't it.

Get Organized Today!
See Your Dealer Or Call
1-800-554-1305 Ext. 400B.

NewWave

The Easy Desktop Manager For Windows™



© 1992 Hewlett-Packard. Fax inquiries 408-720-3560. NewWave, The Easy Desktop Manager For Windows, and The Easiest Way To Organize Your Work are trademarks of Hewlett-Packard Company. Microsoft Windows is a registered trademark of Microsoft Corp.

Circle 133 on Inquiry Card

Sun Expands Alliance With Russian Computer Scientists

REDWOOD CITY, CA—Sun Microsystems (Mountain View, CA) has hired 33 top Russian computer scientists, including supercomputer designer Boris Babaian, to write compilers and other development tools for Sun Sparcstations. Working under exclusive contracts at three locations in their home country, the Russians will apply their knowledge of multiprocessing architectures to a new generation of Pascal and FORTRAN compilers and optimization tools.

"We think this can be a precedent for other research-and-development-intensive companies," said Scott McNealy, president, CEO, and chairman of Sun Microsystems. Babaian, a longstanding member of the Russian Academy of Sciences, is known as the "Seymour Cray of the Russian computer industry." He was the principal architect of the Elbrus-3 supercomputer, which was reputed to be three times faster than a Cray Y-MP, the fastest U.S. supercomputer. The 16-processor Elbrus-3 uses an architecture known as fine-grain parallelism to achieve its high performance. In the 1970s, Soviet computer designers pioneered multiprocessing architectures to overcome the limitations of their slower processors, and their long experience in writing software for those architectures is what attracted Sun's attention.

Sun first contacted the Russians in 1990.

Negotiations were delayed by legal barriers and the deepening political turmoil in the crumbling Soviet Union. In March, Sun formed the Moscow Center of SPARC Technology and contracted with Babaian for basic research. The latest agreement goes far beyond that by integrating the Russians into Sun's U.S.-based development efforts. It's a rare example of a Western company employing Russians to produce high-technology commercial products.

The Moscow team will focus on the Sparc compiler Optimizer, a performance-enhancing tool for SPARC applications. Two other teams in St. Petersburg (formerly Leningrad) and Novosibirsk (Russian Siberia) will work on the Sparc compiler FORTRAN and Sparc compiler Pascal products sold by SunPro (Mountain View, CA), the software development arm of Sun. The projects are scheduled for completion in 12 to 18 months.

Trade restrictions left over from Cold War days made the alliance difficult to cement. Sun will equip the Russians with workstations, but it is forbidden to provide machines more powerful than a Sparcstation 1+. Ironically, if current restrictions are not lifted, the Russians won't be allowed to buy the finished software they help develop, said Jon Kannegaard, SunPro's vice president and general manager.

—Tom R. Halfhill

PCMCIA Standard Faces Incompatibilities

PCMCIA (Personal Computer Memory Card International Association), the standard for credit-card-size devices to hook up with laptop and palmtop computers, is off to a fast, and incompatible, start. At the Fall Comdex, about 50 vendors will be showing computers and peripherals that use the PCMCIA interface. The problem is that a significant number of them won't be able to talk to each other.

PCMCIA got popular too fast. While the physical specification is well established, some critical pieces of the software standard are still missing. Socket services, which interface with the hardware, need to be reworked to meet the changing uses of PCMCIA. The card services layer, which is the layer above the socket services layer, isn't complete yet. In their eagerness to use PCMCIA, manufacturers are working around the missing pieces by hooking into higher levels in various, most-

ly incompatible, ways.

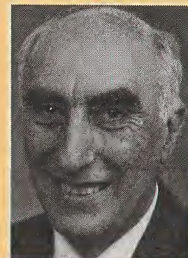
PCMCIA is being stretched beyond what its designers originally envisioned. PCMCIA was supposed to be for memory cards, but it is becoming the standard for connecting any kind of peripheral to a notebook or palmtop computer. It is compact and power-efficient in a way that alternatives (e.g., the ISA bus) are not.

Because manufacturers are writing their own versions of the missing software, most of their work will probably have to be redone when the standard is made final. PCMCIA thinks the fuss is overblown. Brendan McGuire, executive director of PCMCIA, said he expects some incompatibilities. "That's inevitable" with a new standard, he said. But he added that incompatibilities will be minor and companies have said they will release compatible versions of their software as soon as possible.

—Rick Cook

NANOBYTES

"In our country, all computer industry has stopped due to the economic situation and other circumstances," says **Boris Babaian**, a Russian supercomputer architect



who's working with Sun Microsystems. Babaian explains that thousands of engineers are jobless and that the native computer industry cannot compete with the Western technology now flooding his homeland. □

Recently speaking on the promise of computer-supported collaboration, Intel chairman **Gordon Moore** prophesied that the computer's growing ability to simultaneously manipulate voice and image data will lead to a new era of international productivity and cooperation. Moore predicted that it will soon be possible to carry on a conversation with a personal computer. He said that he was "frankly amazed" that voice-activated menus and command recognition have taken so long to appear in the DOS marketplace. "Most of the people that use computers want to just use them and not have to work with them," he said. □

The advent of low-cost PCs—and razor-thin margins for PC manufacturers—is arguably the story of 1992. Companies such as Compaq have been hard-pressed to keep up with the demand for the low-end machines, and yet, according to **Michael Dell**, president and CEO of Dell Computer, the industry has not responded properly to customer demands. Speaking to an audience of mostly U.S. government workers, Dell said, "You've invested \$80 billion in computer products, and it's resulted in a 1 percent increase in productivity." After a pause, he added, "I would hate to be the CEO of a company with those results." □

NOW JUST \$495!
(suggested retail price)

What Comes After Spreadsheets? Introducing New CA-Compete!

Up to 12 different dimensions you can navigate through with the click of a mouse.

Use simple English—no column or row references needed.

Name and save multiple views. Look at up to 12 at a time.

Extra sheets available for custom reports and additional calculations.

CA-Compete! - BUSPLAN1.MDL

File Edit Formula Format Options Tools Window Help

GLOBAL =Sales:Total Cost

Product Actuals - 1989

	LPs	CDs	Tapes	Total
Units	19,499	34,678	23,597	77,774
Price	\$0.75	\$1.40	\$1.05	\$1.07
Sales	\$14,624	\$48,549	\$24,777	\$87,950
COGS	\$13,671	\$24,314	\$16,544	\$54,529
SG&A	\$1,462	\$4,855	\$2,478	\$8,795
Total Cost	\$15,134	\$29,168	\$19,022	\$63,324
Profits	(\$509)	\$19,381	\$5,755	\$24,627

Eastern Forecast - Pdt A

	1989	1990	1991	1992
% Sales	100.00%	100.00%	100.00%	100.00%
Sales	100.00%	100.00%	100.00%	100.00%
COGS	81.57%	79.63%	77.77%	77.77%
SG&A	12.00%	12.00%	12.00%	12.00%
Total Cost	93.57%	91.63%	89.77%	89.77%
Profits	6.43%	8.37%	10.23%	10.23%
Tax	2.70%	3.52%	4.30%	4.30%
Net Income	3.73%	4.86%	5.93%	5.93%

Variance Report by Product Eastern Region - 1989

	Actual	Plan	Variance
LPs			
Units	19,499	21,344	(1,845)
Price	\$0.75	\$0.75	\$0.00
Sales	\$14,624	\$16,008	(\$1,384)
Cost of Goods Sold	\$13,671	\$13,058	\$613
Selling & Admin.	\$1,462	\$1,921	(\$459)
Total Cost	\$15,134	\$14,979	\$155
Profits	(\$509)	\$1,029	(\$1,539)

CDs

	Actual	Plan	Variance
Units	34,678	30,200	4,478
Price	\$1.40	\$1.40	\$0.00
Sales	\$48,549	\$42,280	\$6,269
Cost of Goods Sold	\$24,314	\$18,476	\$5,838
Selling & Admin.	\$4,855	\$5,074	(\$219)
Total Cost	\$29,168	\$23,549	\$5,619
Profits	\$19,381	\$18,731	\$650

Tapes

	Actual	Plan	Variance
Units	23,597	26,100	(2,503)

Global formulas you can apply to a range of cells.

Presentation-quality output with fonts, borders, and shades.

Looks like a spreadsheet with standard commands you know, like cut, paste, copy, and annotate.

Chosen "Best of 1990" by PC Magazine.*

Welcome to the world of multi-dimensional modeling & viewing.

Unlike two-dimensional spreadsheets, CA-Compete! lets you model up to 12 different dimensions and navigate between them instantly with the click of a mouse. And CA-Compete!™ speaks English too, so you can use recognizable names you define, like Sales, Units, Costs and Profit instead of cryptic column and row references. For smarter

- Tools**
- Allocate...
 - Curve Builder...
 - Forecast...
 - Audit Trail...
 - Goal Seek...
 - Data Table...

Audit (Product Actuals - 1989)

LPs Profit: 1989 Actual East	
=Sales:Total Cost	=(509-3859181733)
=COGS	=SG&A (15133-6338591817)
=ALLOCC(Units:LPs)	Units:Total (13671-2088591817)
=COGS	=Price (14529-186)
=SUM(Price:LPs)	(87980-3)
=Price:LPs	=1452425
19499	

decision-making there's a broad range of powerful tools like Goal Seek, Allocate, and Forecast, so you can perform extensive "what-is" and "what-if" analyses.

You can also trace the origin of any value with a quick, graphical Audit Trail Tool.

CA-Compete! reads and writes Lotus® 1-2-3®, Excel, dBase®, ASCII and

Goal Seek

Target Cell: LPs:Profit:1989:Actual:East

Initial Value: (509)

Current Value: (509)

Goal Value: 1000

Source Cell to be Modified: Price

Cell Value: 0.75

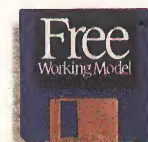
Buttons: OK, Cancel, Audit, Options, Seek, Step, Recalculate



Script Files so you can work with all of your current files.



And with Windows' Dynamic Data Exchange, you can link your data dynamically with any other Windows program. Call 1-800-CALL CAI today to get a CA-Compete! Working Model. It's your chance to get a free glimpse of the future.



COMPUTER ASSOCIATES
Software superior by design.

ARES GIVES YOU ONLY

The gods must be on ARES' side. Running the ARES was a pleasure...

-Rebecca Rohan

COMPUTER SHOPPER

The ARES 386-40 offers one of the best combinations of price, power and support on the market today.

-S. J. Vaughan Nichols

COMPUTER SHOPPER

ARES' 486 PC features several unexpected and pleasant surprises, making it one of the strongest contenders for your attention.

-Brad Thompson

COMPUTER SHOPPER

ARES has put together a good computer, perhaps the best of the lot.

-Steve Gilliland

COMPUTER SHOPPER

Add up all (the) little extras, and ARES' 386-40 becomes one whopping good deal...ARES is getting a reputation for meticulous detail.....

COMPUTER SHOPPER

As soon as you open the ARES box, you'll be impressed by the care and thoroughness with which ARES has packaged this machine.

-Steve Sagman

COMPUTER SHOPPER

I've seen Gateway's version of the 386SX...am I glad I finally chose ARES.

-Rick Slemmer

Grumman Aerospace

I firmly believe that you can't find a better company than ARES and you can compare them on all fronts. Service, Parts, Quality, Tech Support, and the friendliest damned people you'll ever talk to.

-Joseph Rondini

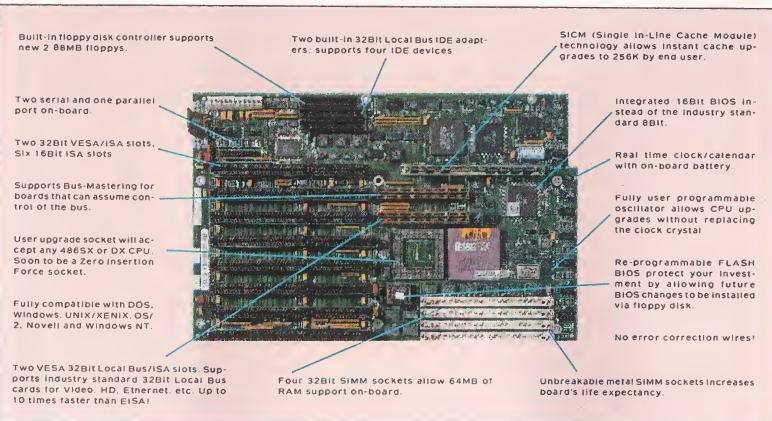
New Milford, Connecticut

I am one who is known in various places as a hard man to deal with because I demand excellence in value and service as a principal of business. I find however that I don't need to demand it with your company. It is given as a matter of course.

-Ronald O. Koski

Adrian, Michigan

Many will follow a familiar path, others feel compelled to set their own distinct course. Those who choose ARES place themselves firmly in the second category. The new ARES VL-Bus motherboard represents a new beginning in PC performance by incorporating the compatibility of the VESA (Video Electronics Standards Association) Local Bus along with the unprecedented power of the Intel 80486 line of processors. Our steadfast goal is to make you an ARES customer for life by offering you guarantees and support policies that our competitors dare not match. ARES takes the time to do things right...recognized throughout the industry for our many design accomplishments, such as:



ARES 250-watt power supply is standard in desktop as well as tower systems.

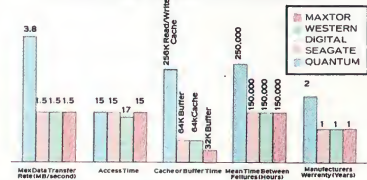
ARES technicians neatly fold and silicone all cables to their sockets, and braid all wires, tie them and seal them onto their fasteners. So ARES systems have better case airflow, increasing component life by keeping them cooler - often just 2-3 degrees above ambient room temperature!



Innovative Motherboards, Award Winning Video Cards, Superior Hard Drives... Uniquely Combined To Carry On The ARES Trademark Of Excellence.

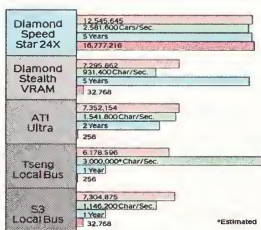
It's The HEART of ARES

ARES New Quantum Hard Drive: More Speed More Space, Same Price, Compare...



With greatness of heart comes strength of body. And our strength lies in the multitude of ARES systems owners who express their enthusiasm and appreciation to us every day in customer satisfaction letters, follow-up calls, and on PRODIGY.

A personal computer company should do many things...It should inspire confidence and a sense of freedom. It should have a reputation that earns respect. It should, from day one, provide exactly what you need - both hardware and applications solutions. And do so without costly "free" software that you'll never use. It should offer a boundless horizon with the flexibility to grow and expand in limitless directions. THIS /SARES! If you're looking for everything a personal computer should be, there is only one choice... AND ARES WAS THE CHOICE OF:



* Dunn & Bradstreet * Honeywell * U.S. Air Force
* Ziff-Davis Publishing * Eveready Battery * U.S. Navy
* J.D. Power * U.S.D.A. * TWA
* U.S. Dept. of Defense * NASA * P.P.G.

Come Experience The Exhilaration Of Excellence. Join The Growing Family Of Satisfied Customers... It's The BODY of ARES

ARES
MICRODEVELOPMENT, INC.

THREE SMALL FEATURES.

The soul of an ARES is found in the people that stand behind it. Our standards are the same as yours: quality first. Our technology may be envied and emulated throughout the industry, but our people, proud and dedicated, are our greatest asset.

Our objective is customer satisfaction. We begin with the highest quality product, and couple it with unparalleled service. We build a reliable product with dependable and responsive people to back it up. From the onset of design to the final process of packaging and delivery, quality is paramount.



COMPARE...	ARES	ZEOS	GATEWAY	DELL
Technical Support 24 Hours 7 Days	•	•		
QAPUS Diagnostics w/ Remote Access	•			
2 Year Free Parts Warranty	•			
Lifetime Limited Warranty	•			
Free 1st Year On-Site Service	•		•	•
2nd Yr. On-Site Service Contract Offered	•			
Upgradable Mainboard	•	•		
386 Local Bus Architecture	•			
128K External Cache	•			
550+ Tower Case Option	•		•	•
Free Backup Board Service	•	•	•	•
Made in U.S.A.	•	•	•	•
60 Day Money Back Guarantee	•			
Performance Guarantee	•			

A free Fixup Disk enables you to restore lost files and connect to ARES' bulletin board system via your modem to download free software. The disk also facilitates your modem link to QAPUS Remote Diagnostics, a system which lets ARES technicians support you remotely with diagnostic and repair services.

ARES operates a 24 Hour, 7 day-a-week BBS system for your shareware and support needs.

A two-year on-site TRW service (1 year free) includes air express parts replacements via Federal Express.

ARES was the first to offer a two-year warranty. The first with a 60-day no questions asked return policy. The first with IDE, Quantum, and Diamond SpeedStar. Among the first to provide 24 hour per day, 7 day-a-week technical support and to apply no surcharge on credit card purchases. ARES was the first - and virtually the only - firm that does not charge until shipment. And now ARES is the first to offer a fully upgradeable motherboard supporting 64MB of RAM and lightning fast 32bit Local Bus architecture. The very first. Ask our competitors if they can match ARES!

A Two-year warranty on all components and lifetime warranty on labor.

A 60-day no questions asked return policy - with no restocking fee.

ARES technical support lines open 24 hours per day, 7 days-a-week. Should you need our expert help your wait will usually be measured in minutes, not days.

A Two-year warranty on components from ARES - and from the component manufacturers. Quality through and through!



ARES 486-33EISA

Intel 80486-33DX Processor
Intel 80487 Math Co-processor
256K External Cache
8MB RAM expandable to 64MB on board
Quantum 240MB SCSI Hard Drive
SCSI Hard Drive Controller
Teac 1.44 and 1.2 MB Floppy Drives
Viewsonic 6e SVGA Non-Interlaced Monitor w/.28 Dot Pitch
Diamond Speedstar 24X Graphics Accelerator Video Card
Your choice of ARES Platinum Series Keyboards
2 Serial and 1 Parallel port
DOS 5.0, Windows 3.1 pre-Installed w/documentation
ARES FixUp Program v. 3.0
Authentic Microsoft Mouse

\$3,175⁰⁰

486-50EISA

A Same configuration as above.

\$3,549⁰⁰

ARES 486-25SX

Intel 80486-25SX Processor
4MB RAM expandable to 64MB on board
Quantum 127MB IDE Hard Drive - 64 Read AND Write Cache
Teac 1.44 and 1.2 MB Floppy Drives
Viewsonic 6e SVGA Non-Interlaced Monitor w/.28 Dot Pitch
Diamond SpeedStar 24X Graphics Accelerator Video Card
Your choice of ARES Platinum Series Keyboards
2 Serial and 1 Parallel port
DOS 5.0, Windows 3.1 pre-Installed w/documentation
ARES FixUp Disk
Authentic Microsoft Mouse

\$1,995⁰⁰

ARES 486-20SX

Same configuration as above.

\$1,895⁰⁰

ARES 386-33DX

Same configuration as above.

\$1,795⁰⁰

ARES 486-33DX

Intel 80486-33DX Processor
Intel 80487 Math Co-processor
64K External Read AND Write Cache
4MB RAM expandable to 64MB on board
Quantum 170MB IDE Hard Drive or Maxtor 213MB IDE Hard Drive
Teac 1.44 and 1.2 MB Floppy Drives
Viewsonic 6e SVGA Non-Interlaced Monitor w/.28Dot Pitch
Diamond Speedstar 24X Graphics Accelerator Video Card
Your choice of ARES Platinum Series Keyboards
2 Serial and 1 Parallel port
DOS 5.0, Windows 3.1 pre-Installed w/documentation
ARES FixUp Program v. 3.0
Authentic Microsoft Mouse

\$2,395⁰⁰

Same configuration for...

ARES 486-50DX2 ARES 486-50DX

\$2,495⁰⁰ \$2,595⁰⁰

ARES 486-66DX

Same configuration as above.

\$2,895⁰⁰

Quality Product,

Quality Software,

Quality People It's The **SOUL** Of ARES.

ARES: HEART, BODY and SOUL...Can The Competition Measure Up??

CALL TODAY... We'll Ship Today....800-322-3200

Circle 248 on Inquiry Card.

Problems? Forget It. The ARES 386 Mini Tower gave relentlessly quality performance.

-Rebecca Rohan
COMPUTER SHOPPER

I called 11 different companies to research my purchase. The ARES sales rep. was by far the most knowledgeable and courteous. He got my order.

-Douglas A. Gifford
U.S. Embassy, Madrid

ARES sold me the first time on system quality and performance; but more importantly, I was sold the second time on customer support.

-John M. Messineo
Tampa Florida

I purchased an ARES because they are truly a people company. They made me feel that I was the most important customer to them.

-Carol Green
New York, New York

In short, ARES just reeked of quality throughout, from the sales rep. to the follow up letters, to the system itself and the documentation. I am very pleased with ARES.

-Prof. Jim Wade
Germantown, Pennsylvania

The 486-33 Sonic is an outstanding buy - and more so because of the company that stands behind it.

-Russ Lockwood
PC

You can return the unit within 60 days if you are still not satisfied, but with service this good, it's not likely that you will need to do this.

PC -William Bettini

ARES has assembled an organization to be proud of and equipment that compares most favorably with any that I have been exposed to (I have worked with both Dell and IBM).

-S. Marvin Freeman
Syosset, New York

Your Package is a class act. I have 8 computers, and this one's packaging, sales, and attention to detail are by far the best of them all.

-Susan Stevens
Memphis, Tennessee

ARES
MICRODEVELOPMENT, INC.

Borland vs. Symantec: High-Level Intrigue

Is it a tempest in a teapot or a full-blown industrial espionage? And just how private is E-mail? That's what people are wondering about one of the strangest scandals to erupt in Silicon Valley in years.

On September 1, Eugene Wang surprised his colleagues at Borland International (Scotts Valley, CA) by resigning to join Symantec (Cupertino, CA). As vice president and general manager of the Languages Business Unit, Wang was one of Borland's top executives.

But the real surprise came after Wang resigned. Borland says it "received information" that Wang had leaked company secrets to Symantec. Borland then accessed Wang's corporate MCI Mail account and read all the messages he had sent over the previous five days. According to Borland, at least 10 of those messages were addressed to Symantec CEO Gordon Eubanks and contained secret information about Borland's marketing plans, recruiting prospects, business strategy, and spe-

cific strategy regarding Symantec.

Borland called the local police and the district attorney, charging that Wang had stolen trade secrets, a felony in California. Authorities obtained search warrants and raided Wang's home and Eubanks's office and two houses. The 12-page list of seized items included computers, disks, and files. The next day, Borland sued Wang, Eubanks, and Symantec.

How did Borland access Wang's MCI Mail? Borland uses MCI for internal communication and pays for its employees' accounts; therefore, Borland had Wang's password, and the company was able to scan his MCI mailbox. Borland says that this is the first time it has read an employee's E-mail.

Symantec won't comment on specifics but denies any wrongdoing. Symantec also accused Borland of "harrassment tactics" and dismissed the situation as a "tempest in a teapot."

—Tom R. Halfhill

C&T Refocuses on Single-Chip Systems

Chips & Technologies (San Jose, CA) says it will no longer make new clones of discrete Intel-compatible 80x86 processors; instead, it will focus its efforts on single-chip systems for the emerging portable computer market. Spokesperson Gavin Bourne put a positive spin on the company's fourth-quarter financial loss of

about \$8.8 million, saying C&T is now shipping its Super386 processors and SuperMath coprocessors in volume. C&T will continue to ship its Super386DX processor but has canceled its plans to release the Super38600SX and 05SX processors. "The [SX] parts are here, but clearly, the market has collapsed," he said.

—David Andrews

New RISC Chip to Emulate 486 and 68040

International Meta Systems (Torrance, CA) claims it has a new RISC microprocessor that can emulate an Intel 486 or Motorola 68040 at their full native speeds and at a fraction of their cost. IMS is pitching the CPU for pen computers that need high performance for tasks such as handwriting recognition. It also says the chip could be used in a "chameleon computer" that runs PC and Mac software.

The IMS 3250, slated for mid-1993 production, is a two-chip set with a RISC CPU and an I/O controller. IMS says the 3250 will use 0.7- or 0.8-micron CMOS technology with the equivalent of 400,000 transistors. Clocked at 100 MHz, the CPU reportedly runs at 90 MIPS in native RISC mode.

What sets the 3250 apart from other RISC chips is its programmable micro-

code. Although many CISC processors implement their instruction sets in microcode, most RISC chips do not. Systems designers can reprogram the 3250's microcode using assembler-like tools. IMS says it has written modules that emulate a 486 at 25 MHz and a 68040 at 30 MHz, including FPU support.

To build a computer that runs both PC and Mac applications, a designer would still have to add the appropriate system software. PC clones are easy to make, but a Mac clone would require either licensed Mac ROM chips or their legal equivalent. One possibility is a Mac "compatibility engine" such as the toolbox emulator from Quorum. IMS says the 3250 will cost just \$50 to \$60 in production quantities.

—Tom R. Halfhill

NANOBYTES



Home Row (Clackamas, OR, (503) 656-2995), the developer of the J-Mouse—an

alternative to the traditional mouse for Microsoft Windows—has developed a smoother-functioning version of the device that the company hopes will make the J-Mouse a standard on desktop keyboards. Portable PC manufacturers have already incorporated the J-Mouse into their keyboards so that you don't have to struggle with a klunky trackball. The J-Mouse, which appears as a blue-colored J key in the keyboard, does double duty as a regular alphabet key and as the actual pointing device. Sejin America (Sunnyvale, CA, (408) 752-8447) will include the J-Mouse in a new 101-key keyboard. □

Rumors of the demise of DataPerfect have been greatly exaggerated, says Russ Dastrup, product manager for the WordPerfect database package. Responding to reports in trade papers and in BYTE's September Microbytes claiming that WordPerfect's new WISE (WordPerfect Information System Environment) strategy could mean the end of DataPerfect, Dastrup said the software "is not dead." To the contrary, he says, WordPerfect's board of directors has "made a recommitment to DataPerfect in both development and marketing." A new release 2.3 is expected to ship at the end of October, while work is under way on "a version beyond 2.3," Dastrup says. □

California would gain as much as \$5 billion in reduced fuel costs and increased productivity a year if more workers commuted electronically, a study by the California Engineering Foundation says. The biggest obstacles to telecommuting are structural (e.g., the IRS rules on workers' home offices). □

MX17F
MONITOR
EDITORS'
CHOICE
1992



VISION

GROWS

14" IN 1990. 15" IN 1991. 17" IN 1992.

MAG Innovision wins the Editors' Choice year

after year after year, making us truly the growing monitor company of the nineties. THE LATEST ADDITION TO OUR FAMILY of winners is the sensational MX17F, whose "sharp image and competitive price make it a compelling choice." So do the MX17F's advanced features. We've combined the latest flat square tube technology with Invar Shadow Mask for distortion-free images and 30% more brightness. Dynamic focus circuitry keeps the whole screen razor-sharp. And non-interlaced resolution — up to

1280 x 1024 — assures the best picture possible. ALL IN ALL, this microprocessor-based, digitally controlled display is perfect for Windows®. Find out more. Contact us at 1-800-827-3998, or 4392 Corporate Center Drive, Los Alamitos, CA 90720. Tel: 714-827-3998. Fax: 714-827-5522.

Circle 235 on Inquiry Card (RESELLERS: 236).

© 1992, MAG Innovision. All rights reserved. MAG Innovision and its logo are trademarks of MAG Innovision. Windows is a registered trademark of Microsoft Corp. All other brand and product names are trademarks or registered trademarks of their respective owners.



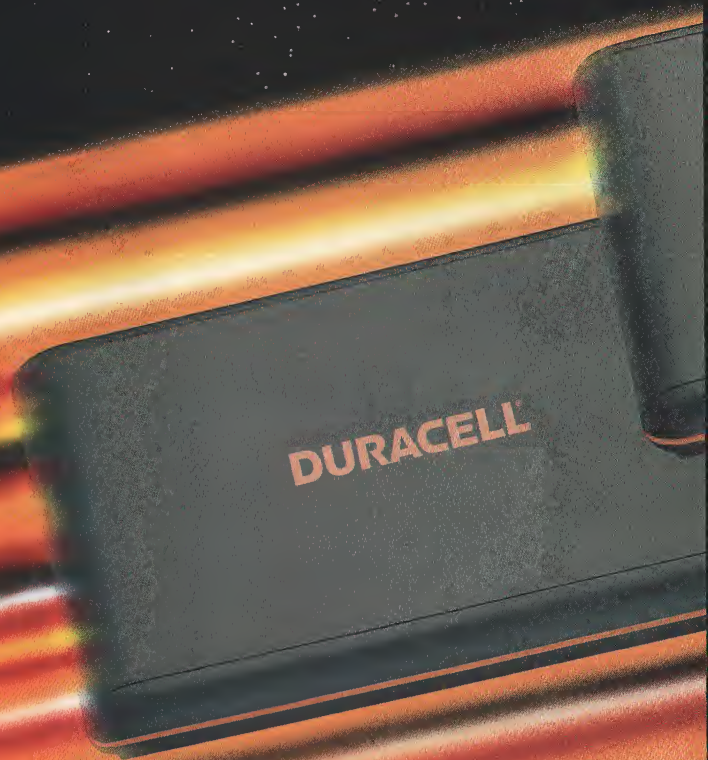
MX15F
MONITOR
EDITORS'
CHOICE
1991



PMV
14VD+
MONITOR
EDITORS'
CHOICE
1990



Duracell Introduces Nickel-Metal Hydride



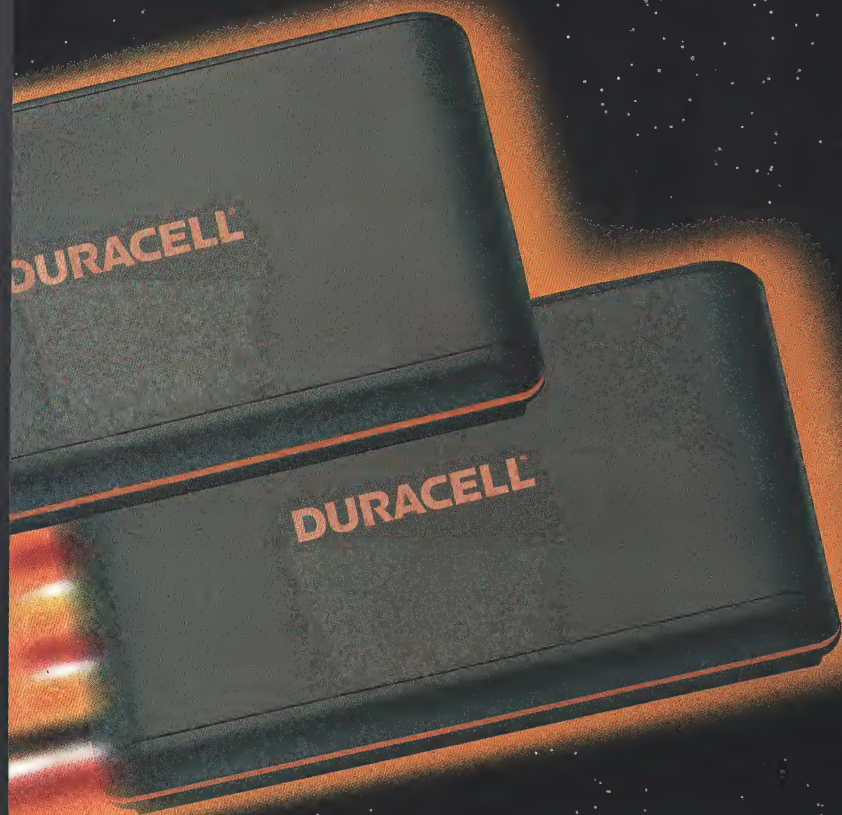
A world of change is coming.

Portable products like computers and cellular phones are fast becoming a part of our everyday life. And as the market for these portable products grows and shifts to mass retail distribution, so will consumer demand for a readily available, long lasting rechargeable battery.

Introducing DURACELL® Nickel-Metal Hydride Rechargeable Batteries, a limited number of standard sized packs that will soon be conveniently available in millions of retail outlets worldwide. Exactly where your portable products must be found if you hope to gain a larger share of the growing consumer market.

Consider the advantages DURACELL Nickel-Metal Hydride Rechargeables offer you, the manufacturer. Up to 40% longer life than ordinary rechargeables.

ces Standard Sized Rechargeable Batteries



Freedom from the burden of custom pack design and inventory. Reduced product costs and cycle time to market. Worldwide availability of replacement packs.

Duracell's leading edge battery technology can make your portable products as convenient, affordable and consumer friendly as your changing market demands.

So if you're a manufacturer of portable computers or cellular phones, join Duracell in a power partnership today.

DURACELL®
RECHARGEABLES



Tandy Goes After the Interactive Home Market

Tandy has joined companies such as Commodore and Philips in the interactive home-learning, information, and education market. Tandy has announced a new CD-ROM-based digital information delivery system that uses the TV as its display. As part of the announcement, Microsoft said that it is developing a modified ROM version of Windows for Tandy's new VIS (Video Information System) multimedia player that's optimized for viewing on TV. Modular Windows titles feature large 3-D buttons and support a simple point-and-shoot remote-control operation.

Tandy will be competing with Philips's CD-I and Commodore's CDTV formats—neither of which will be compatible with VIS—as well as possible future products from Sega, Nintendo, and NEC. But the alliance with Microsoft enables Tandy to attract potentially thousands of developers to Tandy's VIS format: applications developed for VIS will be easily ported from standard Windows to Modular Windows, both companies said. Mike Grubbs, senior director of Tandy's marketing department, said Windows 3.1 programs won't be able to run on Tandy's or other manufacturers' VIS players without at least

some modification to the program's interface and drivers. For example, users interact with CD-ROM Windows applications via the keyboard, and VIS players won't have a keyboard. "But a lot of applications will transfer quite readily," he said. "Adaptations required in the program will be relatively minor."

Tandy envisions VIS as a technology that will be integrated into products tailored to learning, information, and family entertainment, where programs will let viewers interact with pictures, voice, music, and animation. Grubbs said that because Tandy will license the VIS format to other drive manufacturers, including Zenith Electronics, pricing of VIS players will be left to individual vendors. But Zenith's player will sell for about \$700, which is about the same price as a VIS player that Radio Shack will sell.

The VIS player looks like a standard CD audio player (it will play standard audio CDs) but will be more simple to operate, Grubbs said. A typical VIS configuration will use standard TV as its display with stereo sound provided through audio connections to a TV or receiver. VIS players will also have an infrared remote handheld controller, and a Save-It cartridge for saving positions in applications and other user information. Nearly 50 software and content-publishing companies have committed to delivering over 100 VIS titles, which will range from \$29.95 to \$79.95.

Beginning this fall, VIS products will be sold nationwide by consumer-electronics retailers and department stores, including Tandy's own Radio Shack stores under the Memorex label. VIS products are expected to be available in stores before Christmas.

—David Andrews



Tandy's VIS player can play standard audio CDs through the stereo input on a TV or through a stereo amplifier.

PCses Battle for Bandwidth

PCSes (personal communications services) may be in trouble before they even get off the ground. Despite recent FCC approval, the plan to use high-frequency radio to tie together pocket telephones, personal computers, and other kinds of equipment, is facing powerful opposition in the U.S. Senate because of a squabble over frequency allocations.

Recently, a group of computer industry leaders, including representatives from Apple, went to Washington to testify against a proposal that would effectively block PCSes from the wavelengths the

FCC assigned. The FCC chose to assign PCSes to the relatively underused 2-GHz bandwidth. However, *underused* doesn't mean unused. Some corporate communications systems, notably utilities and railroads, use the frequencies. Senator Ernest Hollings (D-SC), chairman of the Senate Commerce Committee, says he will introduce legislation to protect the utilities and railroads if their concerns aren't met. PCS proponents in the communications and computer industries say that Hollings' bill would effectively kill PCSes. ■

—Rick Cook

NANOBYTES

AVI (Audio Video Interleave), otherwise known as Video Windows, Microsoft's device-independent compression technology that's under development, will play a big role in Tandy's VIS format. AVI will let users compress and store video segments on a mass-storage device for later decompression and retrieval. □

The industry shakeup continues to claim victims: Both Momena and Librex have recently bitten the dust. **Librex**, a notebook-computer venture of Nippon Steel, shut down when its parent company decided—not surprisingly—that the computer business was too far afield from steel. □

Momena, a pen-computing start-up that had received an estimated \$40 million in venture funding, fell victim to a depressed economy and a weak market for pen systems. The company's unique *pen-top*, featured on the cover of the November 1991 BYTE, was ahead of its time. Touted as a compromise between traditional notebooks and a pen tablet, it apparently weighed and cost too much in a market that remains skeptical of pen computing. Momena had no other revenue sources to fall back on; after trying for several months to sell off its technology, the company closed its doors in August. □

Acorn Computers, the U.K.-based computer manufacturer, has announced 10 new systems based around the ARM (Advanced RISC machine) chip set. None of the new machines is PC compatible, although many of them are bundled with a DOS emulator and DR DOS 6.0. Acorn argues that it has created a niche market for low-cost RISC machines that don't have to be PC compatible. Acorn's marketing director, Mike O'Riordan, says "No other manufacturer in the world can currently offer RISC computing for under £500." □

**THE
FAX SERVER IS
TROUBLE-FREE.**

**THE
PHONE CALL IS
TOLL-FREE.**

**THE
TRIAL OFFER IS
ABSOLUTELY
FREE.**



It won't cost you anything to evaluate the network fax server that has everything: the new release of Castle FaxPress 3.0. Just call 1-800-359-7654 for a free evaluation unit. That way, you can see for yourself how easy it is to add fax capabilities to your network.

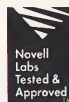
Unlike most fax servers which consist of cards and software installed in a PC, FaxPress 3.0 is fully self-contained—and easy to install, easy to use, and easy to manage.

No other fax server is so trouble-free and no other fax server offers such a range of features. Including a PCL 5 format, that ensures the quality of your faxes by supporting all of the fonts and graphics you get from HP II, III or compatible printers. And auto routing, that automatically delivers private faxes right to the individual's workstation.

Whatever your LAN environment, FaxPress 3.0 fits right in. It's fully compatible with Novell or LAN Manager/LAN Server, and supports DOS, Windows 3.X, MHS-based e-mail, and API for full customization.

FaxPress is also a two-port print server. And it's fully integrated with Novell's Print System, letting each user define where to receive personal faxes. Plus enhanced e-mail faxing, that lets you fax as easily as you e-mail without learning a new user interface.

Best of all, you're free to try the FaxPress 3.0 for 30 days*, absolutely free—just by calling toll-free.

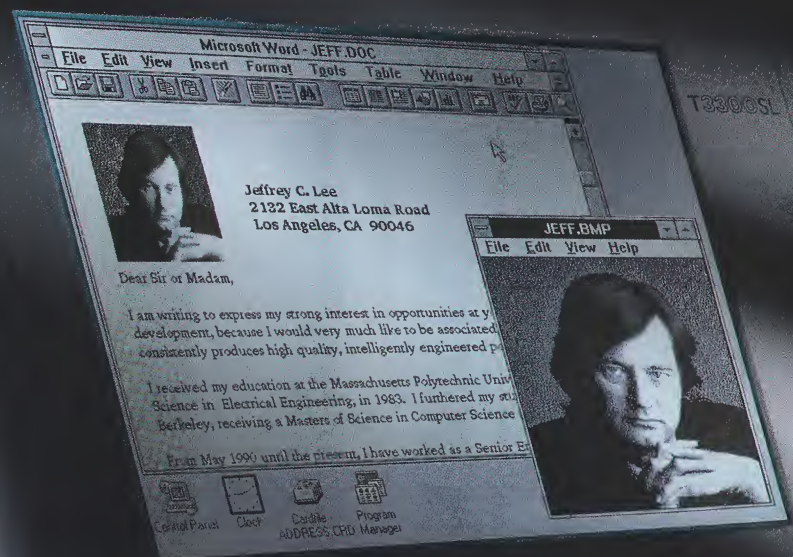


CASTELLE
Enhancing your network productivity.

1-800-359-7654

Castelle, Inc. 3255-3 Scott Blvd., Santa Clara, CA 95054. (408) 496-0474. FAX (408) 496-0502. FaxPress is a trademark of Castelle. Other brand and product names are trademarks or registered trademarks of their respective holders. © 1992 Castelle. *The evaluation unit is available within the U.S. to qualified companies for up to 30 days.

IF YOU CAN FIND ANYTHING WE'VE PLEASE SEND YOUR RESUME TO



THE TOSHIBA T330

OVERLOOKED, ENGINEERING.



August 1992
Toshiba T3300SL

In PC Magazine's
survey of 65 notebooks,
guess who received Editors'
Choice honors.



The T3300SL weighs
only 5.95 pounds and fits in
half a briefcase. (Leaving
plenty of room for your
tuna sandwich.)



You can call real
live Toshiba technicians
toll-free for complete
product support.



They say nothing's perfect.

We say, they haven't seen our T3300SL. The notebook that leaves so little room for improvement, the editors of *PC Magazine* named it one of their Editors' Choices for 1992.

From its bright, easy-to-read LCD screen to its light-as-a-feather weight, the T3300SL may very well be the best-designed 386 notebook you can buy.

And mind you, by "best-designed," we don't just mean "most features."

By "best-designed," we mean a combination of technology that's been chosen because it's even more impressive in the real world than it is on paper.

Our engineers gave this Toshiba a rapid fire 25 MHz 386SL microprocessor, a PCMCIA slot, and your choice of an 80MB or 120MB hard drive, not to mention all the other qualities that make a Toshiba a Toshiba. Namely, standard size keys with full key travel. Compatibility with our DeskStation IV. And Maxtime™ power management, which lets you get the most out of yet another virtuous feature: a powerful Nickel Hydride battery.

So like we said, if you can build a better balanced 386 notebook, talk to Engineering. And if you can't, talk to your nearest Toshiba dealer. The toll-free number is below.

(Surely you didn't think we'd overlook that, did you?)

In Touch With Tomorrow.

TOSHIBA

1 - 8 0 0 - 4 5 7 - 7 7 7 7

© 1992 Toshiba America Information Systems, Inc. The Intel Inside logo is a trademark of Intel Corporation. All products indicated by trademark symbols are trademarked and/or registered by their respective manufacturers.

CORELDRAW 3.0

THE FIRST ALL-IN-ONE GRAPHICS SOFTWARE

In the information-packed '90s, good graphics are more important than ever to get your message across quickly and effectively. And now it's easier than ever to use graphics — with CorelDRAW 3.0! Everything you need is in one value-packed box. There is no longer any need to buy separate illustration, charting, painting, and presentation

packages. CorelDRAW 3.0 does it all with unmatched power and ease-of-use! And, as an unprecedented bonus, Corel has included a CD-ROM with over 14,000 clipart images and over 250 fonts! You'll get fingertip convenience for software that would otherwise occupy over 500 floppy disks and cost thousands of dollars.

Outstanding Reviews!

"CorelDRAW remains the easiest-to-use graphics product on the market...the ultimate graphics bargain!"

PC Magazine, August, 1992

"CorelDRAW – ALL THAT MOST PEOPLE WILL EVER WANT in the way of a graphics software..."

William D. Harrel, Windows Magazine, July, 1992

"Business users who need a wide variety of graphics functions shouldn't pass up this package. It is an amazing bargain."

Luisa Simone, PC Magazine, August, 1992

"CorelDRAW 3.0 is without doubt the most powerful, feature-laden, and best value for money graphics systems for Windows, at any price point. Full stop, end of discussion."

Jon Honeyball, Windows Magazine UK, August, 1992

"Endowed with paint, chart and presentation capabilities, this upgrade of the leading PC draw package is a stunning example of increased power at a reduced price."

Christina Wood, PC WORLD, July, 1992

"It's hard to find a more value-laden offering. We rate the value as excellent."

Mike Heck, INFOWORLD, July 13, 1992

"Total relative value of CorelDRAW modules, clipart and fonts is \$15,000."

John Butler, Seybold Report on Desktop Publishing, July, 1992

"CorelDRAW is a phenomenal bargain"

Michael Burgard, PC/Computing, July, 1992

Suggested retail price
\$595



Outstanding Value!

Other companies need several packages to do what Corel does in one!

Company	Drawing/ Illustration	Charting/ Presentation	Photo- Editing	Fonts	Clipart	Total Cost
Micrografx	Designer	Charisma	Picture Publisher	251	3940	\$1685
Software Publishing Corporation	Harvard Draw	Harvard Graphics: (Windows)	Not Available	62	1600	\$1190
Aldus	Freehand	Persuasion	PhotoStyler	12	305	\$1885
Corel	CorelDRAW!	CorelDRAW!	CorelDRAW!	256	14,000	\$595

No wonder CorelDRAW is the world's best selling graphics software for Windows!

CORELDRAW!

1-800-836-DRAW

CORELDRAW WORLD DESIGN CONTEST

Enter now and win valuable prizes in the monthly contests (from Sept. '92 to April '93). Each monthly winner qualifies as a finalist in the Annual Design Contest in May '93.

Come see us at:
COMDEX/FALL '92
LVCC, BOOTH #1116
Nov. 16-20th, 1992

FREE 24 hour Technical Support

CorelDRAW is MULTIPLATFORM for corporate standardization: Windows, OS/2, UNIX. And soon available on the MAC, and in 20 languages!

Call now for a free demo-disk and brochure!

THE WORLD'S LARGEST COMPUTER SHOW

SÃO PAULO—Large computer trade shows are often held in relatively small places like Las Vegas, Nevada, or Hannover, Germany, where the event dominates the city's existence during its run. But the biggest show of all, by some measurements, is just another layer of crowding in this mammoth, blocky metropolis of over 22 million inhabitants.

Twenty minutes from São Paulo's gridlocked downtown lies the relatively open space of Anhembi Park. This area contains an imposing trade-show building, a modern conference facility, and, between them, the mortar skeleton of an unfinished hotel. The visitor's glance is almost unwillingly pulled to the aborted structure and its dramatic outline. This, in a few acres, is the promise and despair of Brazil: the surge toward development and, at its center, the hulk of an economy gone mad.

Inflation is Brazil's principal, inescapable fact of life—now back to around 20 percent a month after temporary constraints imposed by the reform government of Fernando Collor de Mello in 1990. Businesses continually take the pulse of the economy in order to hedge the inflation with purchases of dollars, precious metals, or goods. It is an ongoing, counterproductive distraction. During a single week last July, the *cruzeiro*, Brazil's basic unit of currency, gained 7 percent against the dollar.

It was the week of Fenasoftware, a contraction of the Portuguese for "National Software Show." Although Max Gonçalves, the 49-year-old dynamo who started the event in Rio de Janeiro a decade ago, is keeping the name, he insists that hardware has fully caught up with software, both at Fenasoftware and in Brazil as a whole.

Banned in Brazil

Starting in 1964, when the country entered a 26-year period of military rule and changed from an agrarian to an industrial economy, walls of protectionism were erected around the computer industry, which the generals considered dangerous and subversive. With the resulting tariffs, software cost Brazilian consumers up to two and a half times what they would have paid in the U.S. In the 1980s, as the developed world latched onto microcomputer power, foreign hardware makers were banned in Brazil, except for a few mainframe and minicomputer producers. One of those, IBM, finally gained access to the microcomputer market in 1991.

In Brazil's banks, law offices, and accounting firms, older generations of computers are treated with respect, even reverence. Often a single central microcomputer is shared by several executives, with lower-level bureaucrats

and secretaries still pounding away at typewriters. The 8088-based XT is common in high-profile places and constitutes almost a third of new sales. Hard drives are frequently no more than 10 or 20 MB in size. Monitors are typically CGA. The most common word processor in the country is WordStar, and a significant proportion of the installed base is WordStar for CP/M.

Although XTs are prevalent here, a visiting journalist found himself the center of attention whenever he prepared to take notes on his XT-compatible palmtop. This was the Poqet PC, an 80C88-based computer, whose 9- by 4- by 1-inch dimensions caught the eye of many Brazilians, to whom such miniaturization seemed irresistibly *encanto* (charming) or *engenhoso* (ingenious).

A Hunger for Technology

Despite a diet of outmoded technology, or perhaps because of it, a hunger for sophisticated products has arisen. In a nation of 150 million citizens, an estimated 1 million computers are in place, perhaps half of them brought in against the rules. The guess is that 80 percent of individual users and 20 percent of corporate users have dealt with smugglers.

The public, deprived of the possibility of shopping, stays abreast by reading. Brazil's major newspapers run regular computer supplements, and there are 17 monthly computer magazines and five semimonthly computer newspapers, all designed to keep readers up-to-date on the latest in cutting-edge, unavailable technology. One is reminded of the movie *Modesty Blaise*, in which a parched Dirk Bogarde crawls through a blazing desert, rasping, "Champagne, champagne...."

The extra excitement this year coincided with long-awaited moves by the democratically elected government, now politically beleaguered, to end trade barriers.

continued

As Brazil's protectionist economy fades away, computer vendors are anxious to show their wares



The bureaucratic hurdle of software registration—and its compulsory and expensive translation, filing of multiple copies, and months of waiting for a ruling—is gone. As for hardware, some of the tariffs have already been reduced and are scheduled to fall to 20 percent by the end of 1994. At that level, Brazilian merchants believe, legitimate products, with their telephone support, documentation, upgrade paths, and so on, have a fighting chance against contraband.

O Estado de São Paulo, the city's leading newspaper, noting that barely 10 percent of the computers in the country are currently networked, predicts that the connectivity market will grow to eight times its present size in two years. And Marcelo Bernstein, editor in chief of *BYTE/Brasil*, while referring to the inflation as "our catastrophe," also calls himself "optimistic" about the computer industry here. He cites estimates that 350,000 new systems will be installed in the next three years. "It's the only way to make economic achievements," he says. "This country understands that there's no way to run any industry without computers."

"The Billion Dollar Show"

No wonder, then, that Fenasoftware attracted a multitude that American showgoing veterans would find difficult to imagine. Published estimates ranged as high as 800,000, but Fenasoftware president Gonçalves, anticipating incredulity at such numbers, hired a group of young, upright Mormons from Salt Lake City to handle the attendee registration process. This group, Market Lead, had firm figures of 450,000 badges sold at US\$5 apiece by show's end; this doesn't count staffers, press, students (who had special badges), and those who may have circulated their cards for a price. That made Fenasoftware '92 the world's largest strictly computer show, in terms of attendance. It also drew more than four times the number of the U.S.'s biggest computer show, Fall Comdex.

On the second day, a delegation from Comdex's producers, The Interface Group, including president Sheldon Adelson, arrived from Boston for a look-see. Interface is one of three sponsoring groups for Comdex/Sucesu-São Paulo, which it billed as "South America's Largest Computer Trade Show and Conference," scheduled for a mere 45 days after Fenasoftware in the same hall.

What the members of the delegation saw as they made the rounds were some 800 exhibitors in a room of 485,000 square feet, in many respects similar to a large trade show in the U.S. Although the familiar logos of IBM, Compaq, Microsoft,

WordPerfect, Lotus, and Borland were in evidence, some of the largest exhibitors—Itautec, Microtec, SID—were domestic hardware manufacturers. Equally large booths represented Brazilian software distributors Compucenter Informática, Brasoft, and Wild West. Most of the hardware groups would return to the Interface show in September.

But surely most impressive to the visitors were the teeming attendees, who swarmed in, eight or 10 abreast, almost

Fenasoft
attendees swarmed
in 10 abreast almost
uninterruptedly.

uninterruptedly. At times, the aisles were almost impassable. And these throngs were not what American show producers sometimes disparagingly refer to as "junk people." Since Brazil does not have U.S.-style distribution channels of computer stores, outlets, or mail-order houses, many attendees were here to buy. Fenasoftware is a cash-and-carry show; hardware and software alike are for sale on the spot.

Some of the paper deals cut on the floor were large-scale. ZIM, a Canadian database management firm with a strong presence in São Paulo, appeared at Gonçalves's office with a case of champagne to toast the signing of a nearly \$10 million contract with a Brazilian firm. Taking into account floor transactions, exhibitor fees, advertising revenue, and attendance charges, the business magazine *Visão Econômica* headlined its story "The Billion Dollar Show."

Few New Products

The missing ingredient usually associated with important trade shows was an array of new products. That is presumably because the country's restrictive trade policies have also restricted innovation. As President Collor said shortly after he took office two and a half years ago, "Protectionism leads to incompetence." Many Brazilians wondered why, with such clear-sightedness, he had not moved more quickly to stimulate the talent and energy of his country's domestic computer industry.

There were some signs, however, of what may prove to be fertile ground. A Brazilian company, Fácil Informática, showed a word processor for Windows that seemed to be competitive with Word for Windows 2.0 and even performed rapid on-the-fly formatting in preview mode. But a shipping copy is not available yet, and there is little reason to anticipate an English-language version for export. There are hopes for a database application development system, Joiner 3.0, which Tuxon Software Development of São Paulo intends to introduce in the U.S. One of its claimed features is that it compiles the same code for DOS or Unix.

Deico Electronics, an established California motherboard manufacturer, is making a move both into Brazil and into the systems business. It has committed to building a factory in Florianópolis, the island capital of the southern state of Santa Catarina, to produce hardware for worldwide export. Ingrid Moos, Deico's CEO, recalls a meeting with the governor of Santa Catarina, who told her, "Go to Singapore. Go to Hong Kong. Go to Taiwan. Get the best deal you can and then come to me. I'll beat it." And, she adds, "he did."

Bridging the Computing Gap

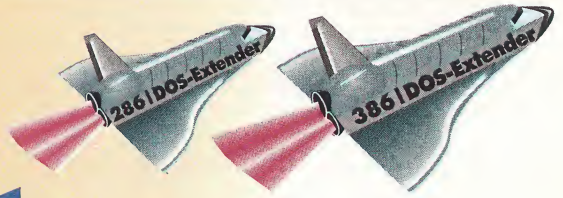
To one viewing Brazil from the perspective of an interested and sympathetic visitor, a striking parallel suggests itself between the nation's computer users and its society as a whole. At the top is a healthy high end, familiar with mainframes, minicomputers, and networks, using Unix-based systems and coding in a variety of languages—the elite. At the bottom is that massive, uncountable population of XT's. And in between, there is a void—virtually no 286s, no 386SXes, no middle class.

When that void is filled, computers may actually make a difference to this inflation-wracked country. Simple software can provide immediate solutions to common, time-wasting bothers. For example, restaurant workers who repeatedly copy new prices onto their menus can have a software package do the conversions and the printing for them. And businesspeople who lose hours of their workday reacting to the *cruzeiro* roller coaster can automate many of their calculations. Perhaps enough time, money, and energy will be saved by such widespread utilizations of computer technology that the hotel in Anhembi Park can, before too long, be finished. ■

Stephen Banker is the Washington-based publisher of Tapes for Readers, a series of audiocassette interviews with contemporary figures. You can reach him on BIX as "sbanker."

The Quality Memory Solution

Phar Lap DOS-Extenders



When your reputation's at stake...

We know how much work you put into building your product. Why use inferior tools that often create more problems than they solve? With a Phar Lap DOS-Extender, you know you're getting industry-leading, market-tested tools that have worked reliably for thousands of developers. Other DOS extenders simply can't measure up. Let Phar Lap show you what a DOS extender should be.

Build multi-megabyte DOS programs with Phar Lap's DOS-Extenders!

286 DOS-Extender™ — it's never been so easy! With our 286DOS-Extender and your Microsoft C/C++, Borland C++ or Microsoft Fortran compiler, you've got all the tools you'll need to quickly and easily build multi-megabyte protected-mode applications — often by simply relinking without making source code changes. Now you can build protected mode applications that access up to 16 megabytes of memory on any DOS-based 80286, 386, 386SX, or i486 PC — without changing development tools! 286DOS-Extender is also compatible with both Borland's Turbo Debugger and Microsoft's linker and CodeView debugger.

386 DOS-Extender™ — the ultimate in 32-bit power. 386DOS-Extender turns DOS into a true 32-bit operating system with a flat, 32-bit address space. Your program can access all the memory available in the machine — up to 4 gigabytes! 386DOS-Extender runs on any DOS-based 80386, 386SX, or i486 PC, and has been used in over 800 applications, including AutoCAD 386 and IBM's Interleaf Publisher. It is backed by a full complement of 32-bit languages, including C, C++, Fortran, Pascal, Ada and Assembler. With true 32-bit performance, you can finally build workstation-class applications for the PC.

Phar Lap Software: Chosen 10 to 1 over all other DOS extenders. Here's why:

	Phar Lap DOS-Extender	Vendor A	Vendor B
Maturity	Over 5 years and 1000 applications	Less than a year	Brand new
Memory Model	Safe	Dangerous	Dangerous
Compatibility	INT 15, XMS, VCPI, DPMI	XMS, DPMI	XMS, VCPI
Library Support	Extensive list of 32-bit libraries	Limited library support	Limited library support
Documentation	Extensive and detailed	Limited	Less than 50 pages

**640K
DOS
Barrier**

Shatter the 640K barrier and build multi-megabyte DOS applications.

**Overlay
Linkers**

No more suffering with overlays or EMS.

**Unsafe
Memory
Models**

Other DOS extenders can let common programming errors cause system crashes.



Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

Trademark holders: 286DOS-Extender™, 386DOS-Extender™ - Phar Lap Software, Inc.; Interleaf Publisher™ - Interleaf, Inc.; Windows™ - Microsoft Corp.; DESQview™ - Quarterdeck Office Systems. Registered trademark holders: Phar Lap® - Phar Lap Software, Inc.; AutoCAD® - Autodesk, Inc.; Borland® - Turbo Debugger® - Borland International, Inc.; IBM® - IBM Corporation; CodeView®, Microsoft®, MS-DOS® - Microsoft Corp.



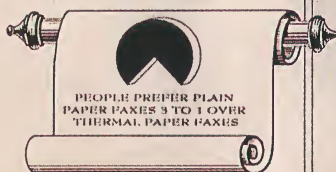
Only one printer can give you this fax.



Our goal at NEC is the complete integration of computers and communications. The Silentwriter Model 95fx is just one of many innovative products that help us to realize this goal. For example, we not only developed the first notebook computer with a built-in phone and fax, we make satellite dishes capable of sending data worldwide.



nce upon a time, all faxes looked the same. *Bad.* But with the Silentwriter® Model 95fx multifunction printer/fax, nothing gets lost in the transmission. Imagine PostScript™ language-quality *faxes* from your printer. It's no fairy tale. Now you can send and receive documents in all their original glory. You'll see beautiful fonts and graphics with none of the dirt and glitches, the jaggies and imperfections, that can turn a wonderful story into a tragedy. Why send a facsimile when you can send an original? Get the NEC Silentwriter Model 95fx multifunction printer/fax and live happily ever after.



PEOPLE PREFER PLAIN
PAPER FAXES 3 TO 1 OVER
THERMAL PAPER FAXES

The End

Actual facsimile generated from a Silentwriter Model 95fx



Computers and Communications


To upgrade your existing Silentwriter Model 95 printer with fax capability (U.S. only), or for more information

And these facts.

- 1 A state-of-the-art 6 PPM laser printer equipped with the latest in Mac® and PC® printer software support—Adobe's PostScript™ Level 2 and HP's PCL5.
- 2 Send and receive faxes in either conventional or PostScript-language formats anywhere in the world.
- 3 Patented Sharp Edge Technology delivers 600 DPI-equivalent clarity in a 300 DPI class.
- 4 Ideal for shared use. Automatic interface switching supports both Macs and PCs simultaneously.
- 5 Under \$2,349 (MSRP). Far less than you'd pay for any printer/fax multifunction combination. If you could even find a comparable product.



The Silentwriter Model 95fx Printer/Fax

Because  is the way you want to go. **NEC**

New Systems... New IBM?

ED PERRATORE

Underdog is here, with fresh new lines of desktop and portable PCs built to oppose the dreaded price-busters and make IBM a contender once again

"Great machines, but can't justify the cost." The words may have varied across corporate America, but the sentiments were consistent regarding IBM. The products were good. The technology was cutting-edge. But as the performance and quality of clones improved, pricing became increasingly important. IBM, came the cry, didn't get it.

Now that IBM apparently gets it, you can get an IBM machine for an affordable price. Big Blue's sweeping announcements opened the fall season with a restructuring of the company's

existing PS/2 line; the debut of a new clone buster line called PS/ValuePoint; and, at last, the introduction of a formidable notebook line. The new product announcements came roughly a month after IBM's formal reorganization of its Personal Systems line of business into the IBM Personal Computer Co., a separate operating unit. With the new operating company in place, the new lines boast a better chance of evolving with the needs of the market place.

The first task IBM faced in developing low-cost desktops was to redefine the PS/2 line, which had ranged everywhere from the 386SX/20-based PS/2 Model 35 to the PS/2 Server 295, the multiprocessing Parallellan superserver IBM resells. The new PS/2 theme? Exclusively Micro Channel architecture, XGA-2 graphics on the motherboard, compliance with the latest ISO specifications for the work environment, SCSI, and fat three-year warranties that include on-site service worldwide. PS/2s also sell with OS/2 2.0 preinstalled.

The PS/2 Models 80 and 90 will remain in production, but IBM plans to phase out the Model 70. New in the line are the 486-based PS/2 76 and 77 and the 486SLC2-based PS/2 56 and 57. While all PS/2s are upgradable, the 56 and 57 have an as-yet unannounced upgrade path. Rely on Intel, if not IBM, to clear up that ambiguity.

Break with the Past

As before, the IBM PS/2s will be sold through dealers and system integrators as well as directly to corporate accounts. In addition to these channels, however, Big Blue will market its new, lower-cost PS/ValuePoint line through distributors as well as by mail order. IBM experimented in the mail-order channel with its PS/2 Models 35 and 40, both of which are being phased out. The only channels through which IBM doesn't plan to offer the ValuePoint are retail stores such as Sears and superstores; these remain the realm of the newly revamped PS/1 line.

New for IBM, and expected to encompass at least the PS/ValuePoint line, is the company's intention to advertise estimated street prices (with a footnote that dealer prices may vary) instead of its own suggested retail price. This departure is good news for consumers, provided that the figures quoted are indeed representative of the average. It also reinforces the message that IBM is meeting traditional mail-order PC makers on their own turf.



IBM's PS/ValuePoint 325T represents the low end of IBM's new value line of reliable, no-frills desktop PCs. The notebook is the ThinkPad 700C, the flagship model of the new portable line.

Under the hood, the three IBM-designed and -manufactured systems that make up the PS/ValuePoint line are easily distinguishable from the PS/2s: Industry-standard—as opposed to industry-leading—is the way IBM describes them. More specifically, the desktop systems are ISA-bus machines with Super VGA graphics, an IDE hard drive, and no external caching. The top-of-the-line model, the 433DX, is a 33-MHz 486 system with 8 MB of SIMM RAM standard (expandable to 32 MB), a 170- or 213-MB hard drive, five drive bays (three of them slim-line) with one 1.44-MB slim-line drive included, and five 16-bit slots, all available since the video and I/O circuitry are integrated on the motherboard. You can upgrade the system with an Intel 486DX/66 processor.

What's notable about this system (and the 486SX/25-based 425SX as well) is that the rumored internal battle over whether a value-line system might sell better bundled with Windows appears to be over. Buy an OS/2-equipped system, after all, and you'll also have virtually all of Windows—perhaps version 3.1 by the time you read this.

The 425SX's standard configuration is 8 MB of RAM (expandable to 32 MB), your choice of an 80-MB or 170-MB hard drive, the same expansion-slot and drive-bay setup as with the 433DX, and upgradability to a 486DX2/25 or 486DX2/66. If you do not need even this level of performance, the PS/ValuePoint 325T offers a 386SLC/25 processor (with an 8-KB internal cache), 2 MB of 70-nanosecond RAM (expandable to 16 MB), and an 80- or 170-MB hard drive. It doesn't come with OS/2 2.0; DOS 5.0 alone is preinstalled. On benchmark tests that we ran on a preproduction 325T, the machine scored midway overall between the Compaq Deskpro 386/25e and the faster Tandon 486/25 on CPU, disk, and video tests.

All ValuePoint systems offer a one-year on-site warranty. IBM claims a 4-hour response time—an improvement over the standard support services that Dell Computer provides for its low-end Dimension line. IBM provides this service through its toll-free HelpWare line, which is staffed around the clock seven days a week.

Overseas, don't expect the PS/ValuePoint line to replace the Ambra clones that IBM's Individual Computer Products International subsidiary is selling on the international market. According to an IBM spokesperson, there is room for both lines,

however much market share the new machines may chip away.

TFTs and Jujubes

Over the years, IBM has earned the Rodney Dangerfield no-respect award for its notebooks; an IBM spokesperson even derided one recent offering as “a 12-pound system with an 8-minute battery life.” However, the company has finally announced an entire line of respectable machines, called ThinkPad. For the one 386SL/25-based model that so far makes up the low-end 300 series, Big Blue had to swallow its pride and have Zenith Data Systems do the building according to IBM specifications.

No such humility need accompany the three-model 700 series. The product we've known as ThinkPad, the pen-based tablet that runs Go Corp.'s PenPoint operating system, is now ThinkPad Model 700T. The star of the line, the 486SLC/25-based Model 700C, is a 7½-pound Micro Channel-bus model (all 700-series models are considered PS/2s from design to distribution) that uses a 10½-inch TFT (thin-film-transistor), active-matrix color VGA display that was developed through IBM's joint venture with Toshiba. Its nickel-metal-hydride battery provides 2 hours of continuous use (with a claimed 4 hours of typical workday use). Dual display is possible for presentations—the screen will even tilt back at a full 180-degree angle to the keyboard so presenters won't have to peer over it at a podium. Both DOS 5.0 and Prodigy software come preinstalled for the price, expected at press time to be about \$4000 on the street.

There's more. The standard 4 MB of RAM comes on a module that slides in and out of the PC from the outside for upgrades to the 16-MB maximum. The 120-MB hard drive eases in and out of a slot the same way, and a metal tab protrudes to let you snap on a small padlock.

Another attraction of the 700C and its monochrome equivalent, the Model 700, is what IBM called The Pointing Stick when it first previewed at 1991's fall Comdex. Called TrackPoint II in its shippable form, this cursor navigation device is sandwiched among the centermost keys like a large Jujube candy; it's even reportedly available in five colors (though only one flavor). Essentially, it allows you quick cursor movement, with minimal finger effort, aided by two “mouse” buttons situated on the plastic casing beneath the keyboard's

space bar. As an inveterate keyboard user, I found it was an advantage to keep my hands in one place even in a GUI environment.

The Model 700 offers the same processor and RAM configuration but has a 9½-inch monochrome supertwist nematic LCD displaying up to 64 gray scales. The 6½-pound unit's nickel-metal-hydride battery is rated at 3¾ hours of continuous use, with a claimed 7½ hours of typical workday use. The Model 700 comes with your choice of an 80- or 120-MB hard drive, which is easily installable in the same fashion as on the 700C. For either model, a docking station is available as well.

Performance-wise, a preproduction model of the Model 700C fared worse in CPU tests than the four 486-based notebooks BYTE reviewed in the September issue (“486 Notebooks Double as Desktops”), however closely related the 700C's 486SLC CPU is to the Intel 486. Where the system soared above the pack was on our disk tests. And in video testing, only the Toshiba T4400SX outraced it.

IBM is ready to relinquish none of its claim of providing some of the most cutting-edge computing power you can find today. But for those who can't afford that PS/2 technology—or don't need it at every station—at last the company has hit on a formula of lower prices for industry-standard systems that maintain the reliability on which IBM made its name. And if the new, lower-cost systems take away some PS/2 profits, well, Big Blue would rather see the dollars go for a PS/ValuePoint than for a Compaq ProLinea. ■

Ed Perratore is a BYTE news editor based in New York. He can be reached on BIX as “eperratore.”

THE FACTS

**IBM PS/2 56, 57, 76, and 77
IBM PS/ValuePoint 433DX,
425SX, and 325T
IBM ThinkPad 700C, 700T, 700,
and 300**

(the prices are unavailable at press time)

IBM Corp.
See your local authorized IBM
dealer
Circle 1080 on Inquiry Card.

Windows for Workgroups

JON UDELL

Microsoft's collaborative Windows environment offers print and file sharing, plus mail and group scheduling

WFW installed smoothly on two NetWare-connected PCs, automatically detecting the NE2000 adapters in use and adding Microsoft's IPX-over-NDIS protocol alongside WFW's native NetBEUI (NetBIOS Extended User Interface); the TCP/IP alternative isn't supported yet. After rebooting, both machines reconnected to the NetWare drives and printers they'd been using. Since I assigned them the workgroup name published by my Windows NT test machine, the WFW

As the world awaits Windows NT, Windows for Workgroups—Microsoft's newest upgrade—offers an impressive set of network services. They function equally well whether you're sharing information and printers between two PCs or working with multiple machines on existing NetWare or LAN Manager networks. WFW is easy to install and use and includes peer-to-peer file, printer, and Clipboard sharing; mail capabilities; group scheduling; chatting functions; and simple network-monitoring tools.

machines could use that machine's shared drives as well as each other's. Given the NT result, it's likely that connecting to a LAN Manager server (one wasn't available) would have been equally painless. Windows lags noticeably when there is heavy access to shared resources, but that's true of all DOS-based peer-to-peer LANs.

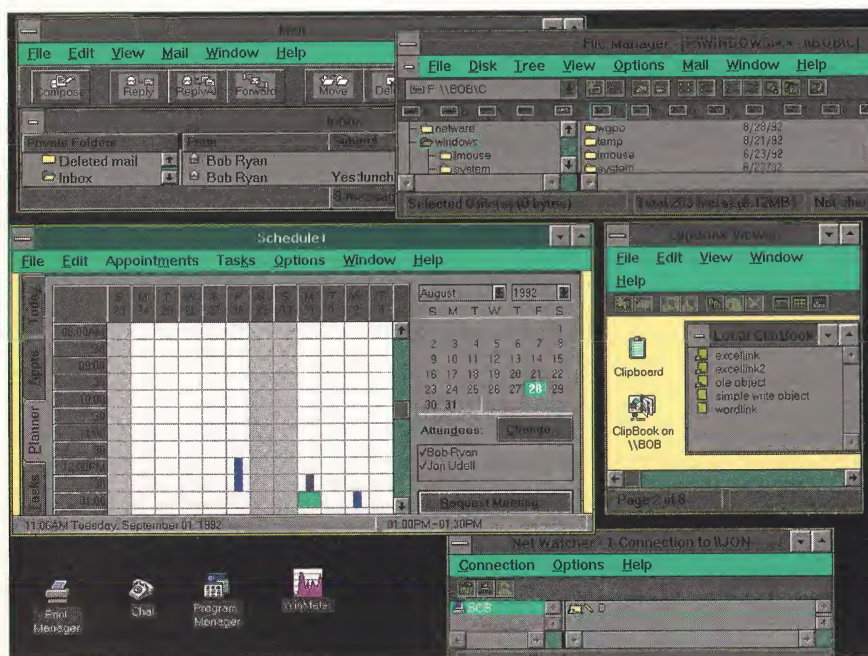
WFW will not republish NetWare or other remote drives as shared resources. Microsoft says you can share out a local CD-ROM drive provided that you use MSCDEX 2.21 and specify the /s switch. There's no remote-access solution for pure WFW networks yet; the best you can do now is dial into a LAN Manager network, using its client software instead of WFW's, and then tap into WFW resources visible on that network.

WFW's dual-shell configuration for NetWare isn't as unwieldy as LAN Manager 2.1's. Microsoft has rewritten components that used to compete for conventional memory or UMB (upper memory block) space as Windows virtual device drivers. The redirector and the NetBEUI transport (as well as the server) run in protected mode, so the real-mode memory hit is almost nil. That's great news even in straight WFW or WFW/LAN Manager environments, since Microsoft's real-mode redirector and transport are bulky.

There's one catch. To benefit, you've got to be running Windows in 386 enhanced mode. For DOS-only and standard-mode Windows users, WFW includes a real-mode redirector and NetBEUI (although no server), but they're poor substitutes for their protected-mode cousins. If you use Windows only occasionally, you'll be better off with one of several excellent peer-to-peer networking products for DOS.

You should note, however, that WFW jumps through hoops to make Windows more attractive as a permanent habitat. File Manager and Print Manager gain toolbars that make sharing out resources, as well as attaching to others' shared resources, mostly a point-and-click affair. It's not as slick as the Macintosh's System 7.0, but it's much better than LAN Manager 2.1, and fully graphical at last. If you're sharing resources, you can use NetWatcher to monitor who's connected to your machine and WinMeter to see how much CPU power the server is stealing from your applications.

WFW packs considerable value beyond basic networking. It includes the newly redesigned Microsoft Mail 3.0 client and



Mail and Schedule+ make Windows for Workgroups a real bargain.

PICTURE WINDOWS.

Picture This... a real-time television monitor built right into your PC... Now, picture using this monitor while running Windows™ 3 applications **at the same time...** And, picture taking that video image and resizing, (**right down to crystal-clear icon size!**) or clicking and dragging it to any position on the screen as easily as moving any other Window...

Now you can! Any Windows 3 user can access 122 channel television reception with the built-in tuner, PLUS two additional video sources, (such as VCR, video camera, laser disk, etc.,) all with stereo audio capability! Automatically fit real-time video images to any size Window while running your other Windows 3 programs. *Hauppauge Computer Works* introduces **Win/TV™**, the Windows television adapter.

Picture Perfect. A "frame-grabber" feature allows you to capture any desired "still" from a video source and save it to disk. With **Win/TV**, you can integrate video images into multi-media applications such as training or marketing presentations. All you need is Windows 3, a VGA monitor, and a system with a spare 16-bit I/O slot, and you are ready to view a whole new world of video creativity!

Picture Yourself owning your own "Windows on the World"! Maybe you want to work on your spreadsheets but don't want to miss an important news flash or a current stock market report. **Win/TV** is *perfect* for you. Keep an eye on current events while keeping control of your inventory... No problem!

Get the new **Win/TV** and open a window on some fresh, new and exciting possibilities.

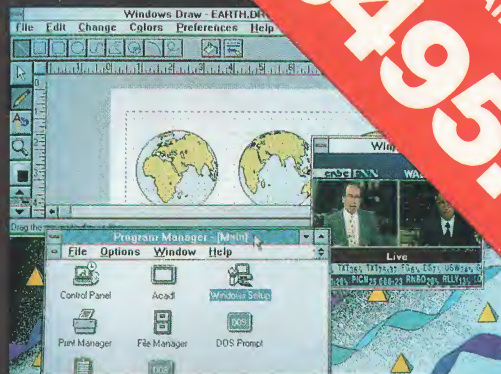
Available Internationally from:

Hauppauge Computer, Australia 07-262-3122 E.I.E., Japan 03-3572-3442
Hauppauge, Germany 02161-17063 Hauppauge, U.K. 071-378-7309

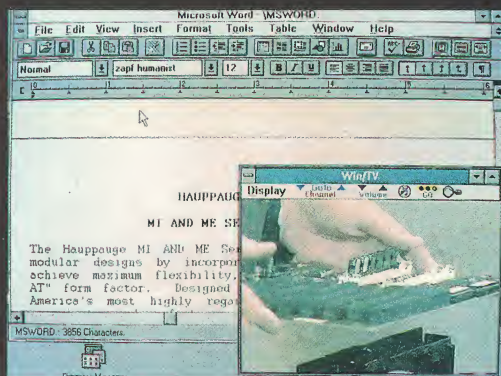
GS00K92AGS6156

Circle 132 on Inquiry Card.

SUGGESTED
RETAIL
\$495.



You're never out of touch with your own personal "Windows on the World"!



Resize or reposition your Win/TV Window anywhere on the screen—while running other Windows applications.



Capture the perfect "still" with "Frame Grabber" feature—great for presentations with impact.

Hauppauge!

Hauppauge Computer Works, Inc.
91 Cabot Court • Hauppauge, N.Y. 11788
In N.Y.: Tel: (516) 434-1600 • Fax (516) 434-3198
Toll Free: 800-443-6284 • In Europe: (49)-2161-17063

NEWS

FIRST IMPRESSIONS

Making the best
better wasn't easy,
but we did it
"AGAIN"

Introducing
Model 24SII DES
Printer sharing
at it's best!



The New Model 24SII DES data exchange system is printer sharing at it's best. Now network workstations, file servers, graphic workstations, and PCs can off-load print jobs at the blazing rate of 60,000cps parallel or 46,000cps serial.

If you want to eliminate the need for multiple laser printers without losing productivity; off-load network print jobs faster; or increase your printing throughput; the Model 24SII DES is for you.

Contact a BayTech representative today for more information on the best printer sharing solutions available.

- Expandable from 4 to 24 ports
- Compatible with Windows®
- Computer-to-computer communication for file transfer or modem sharing
- Up to 16MB buffer
- 1 year warranty

SEE US AT BOOTH #N6434

COMDEX/Fall '92

Because Resources Should Be Shared

BayTech

Data Communications Products Division

200 N. 2nd St., P.O. Box 387, Bay St. Louis, MS 39520
Fax: 601-467-4551 Phone: 601-467-8231 or toll-free

800-523-2702

the new (to Windows) Schedule+ application (see the screen). Mail uses the MDI (multiple document interface) to create its own miniature desktop for in-box, out-box, and user-created folders. It supports drag-and-drop transfer of messages among folders, and it also handles drops from File Manager by attaching the dropped file to a new message and prompting you for an address. The message editor supports the OLE Insert Object... command, so you can embed pictures or voice annotations in messages.

In a stand-alone workgroup, one machine has to own and share out the directory tree that is the "post office," and it must always be available. Alternatively, a workgroup attached to a server-based LAN can locate the post office at the file server, although I had to trick Mail into using NetWare for that purpose. Mail rolls its own directory services; it can't acquire the user databases of NetWare or LAN Manager, nor can it synchronize with WFW's distributed machine-name/password data. So on my NetWare-attached WFW machine, I have to log in three times: to NetWare, to WFW, and to Mail. To send mail to other workgroups or to the outside world, you'll generally need a server edition that can route mail through gateways to foreign destinations.

WFW supplies a scaled-down version of MAPI, Microsoft's messaging API, for Mail's use—and for any other program that wants to exploit it. Schedule+, which integrates tightly with Mail, is the other obvious MAPI client. There's also a File Manager extension that, if named as an add-on in WINFILE.INI, appends a send-file button to File Manager's toolbar.

WFW's generic support for mail-enabled software may change how you work even more than its file-sharing features do. If I send you a document via a shared directory, I still have to tell you where I put it, what it represents, and when you can retrieve it. I may also need to configure that shared directory for privacy. If I mail you the document, the meta-data ("final version, includes your changes") and the data arrive in your private mailbox.

I can also send you a document, or part of a document, by way of WFW's networked Clipboard. Built around the network DDE toolkit, the WFW Clipboard viewer becomes a "ClipBook viewer"—essentially a Macintosh scrapbook with Publish/Subscribe capability. If I connect to your ClipBook, I can transfer "pages"

you've chosen to share onto my Clipboard and then into my applications.

Like MAPI, NetDDE could be an important enabling technology. The Chat program uses it, and other applications will surely follow. Would-be NetDDE developers may rightly wonder, though, how the protocol fits in with RPCs (remote procedure calls), Windows sockets, and a variety of other network IPC (interprocess communications) mechanisms lately advanced by Microsoft.

WFW's most ambitious push into the groupware realm is Schedule+, a personal planner and meeting maker. I can invite you to a meeting by picking your name out of Mail's address book. Schedule+ merges our schedules into my planner and picks the first slot that's mutually available. Then it mails you an invitation form. If you confirm by return mail, the meeting is booked and appears in our planners.

The only hitches are that Mail must be active to keep your schedule up to date and Windows briefly halts when Mail polls for messages. Fortunately, Schedule+ lets you delegate appointment-making to an assistant who can act as your proxy.

This is potent stuff. WFW pushes mail-enabled groupware into the mainstream, raising users' expectations of what their networked software should do. It isn't Lotus Notes for the rest of us yet, but it's a big step in the right direction. ■

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell," or on the Internet at judell@byteph.byte.com.

THE FACTS

Windows for Workgroups

\$250 (tentative); upgrade from Windows 3.1, \$100 (tentative)

System requirements:

Minimum: a 286 with 2 MB of RAM and 10 MB of free disk space.
Preferred: a 386 with 4 MB of RAM and 10 MB of free disk space.

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98502
(206) 882-8080
fax: (206) 936-7329

Circle 1083 on Inquiry Card.

Cool, Quiet, Reliable Power

ECONOMICAL UNITS

These UL/CSA approved, fully-tested power supplies are the best basic units available.

STANDARD 200 XT	\$69
STANDARD 205 SLIM	\$89
STANDARD 220 BABY	\$89
STANDARD 220 AT/TOWER	\$89

ULTRA-QUIET UNITS



Unrattle your nerves with a Silencer power supply. They're cooled by our ThermoSense SQ, a custom, variable-speed fan that automatically maintains the correct system temperature while reducing noise up to 95%. Virtually inaudible! Perfect for the executive suite or home office.

SILENCER 205 SLIM	\$119
SILENCER 220 AT/TOWER	\$129
SILENCER 270 AT/TOWER	\$179

HIGH-PERFORMANCE UNITS



Upgrade your computer with one of our premium Turbo-Cool power supplies—the choice of PC professionals. You'll get 50% - 100% more power, built-in line conditioning, a dual-stage EMI filter, super-tight regulation, ultra-clean DC output, our high-capacity ThermoSense variable-speed fan (300W models), UL/CSA/TUV approvals, and a no-hassle 2-year warranty! Ideal for high-end workstations and network file servers.

TURBO-COOL 200 XT	\$159
TURBO-COOL 300 SLIM	\$169
TURBO-COOL 300 BABY	\$169
TURBO-COOL 300 AT/TOWER	\$189
TURBO-COOL 450 AT/TOWER	\$349

REDUNDANT POWER SYSTEM

Eliminate the risk of costly downtime or data loss due to power supply failure with the TwinPower 900 redundant power system. The TP900 consists of two Turbo-Cool 450 power supplies in parallel, utilizing a special power-management interface module. The system provides complete power redundancy with hot-swap capability.

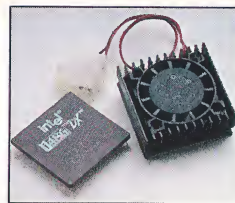
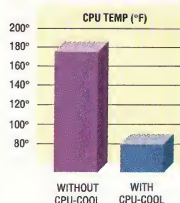


- **Way More Power.** With 50 amps of 12-volt power available for start-up, the TP900 easily runs up to 13 power-hungry drives. Perfect for the next generation of super network servers.
- **No Downtime, Ever.** Each TC450 has an MTBF of over 100,000 hours. In the unlikely event that one should fail, an alarm sounds, and the computer is sustained by the other TC450, while the user simply swaps in a new unit.
- **Allows Redundant UPSs.** Each of the TC450s can be connected to a separate UPS. Should one fail, backup power is retained from the other.

The TwinPower 900 comes in a monster case that holds two TC450 power supplies, the interface module, 6 fans, an 8-slot or 12-slot motherboard, and up to 13 drives. So, not only do you get the ultimate in power and reliability, you also get the ultimate in system expandability!

TWIN-POWER 900 W/CASE	\$1695
-----------------------------	--------

486 CPU COOLER



Prevent random system crashes and extend the life of your 80486 processor by more than 10 times with the CPU-Cool. Reduces the operating temperature of a typical 486-50 from 185°F (Intel's max. spec) to a cool 90°F! Consists of an ultra-quiet mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

CPU-COOL	\$39
----------------	------

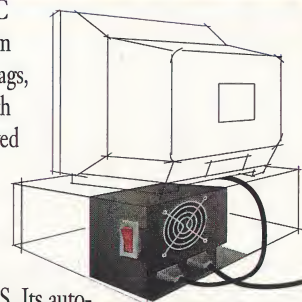
WE REPAIR ALL BRANDS

We provide fast, low-cost, expert repairs and upgrades on Compaqs and other proprietary computer power supplies. Requests for custom outputs, cable harnesses, and cooling fans are welcome.



INTERNAL ON-LINE UPS

Protect your PC and its data from power surges, sags, and outages with our UL-approved InnerSource, a combined AT/Tower power supply and on-line UPS. Its auto-recharge battery provides up to 15 minutes of backup power for both your PC and monitor. This reliable, integrated protection costs less than an equivalent 550VA external UPS, and it saves space too! A Novell interface is available.



INNERSOURCE AT/TOWER	\$349
----------------------------	-------

PC POWER & COOLING, INC.
"THE LEADER OF THE PACK"

5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

Most orders shipped same day. We accept Visa, MC, COD, or PO on approved credit. Turbo-Cool and TwinPower models guaranteed for 2 years. All other products guaranteed for 1 year. Hours: 7 a.m. - 5 p.m. (PT) Mon. - Fri.
©1992 PC Power & Cooling, Inc. Silencer, Turbo-Cool, ThermoSense, TwinPower, CPU-Cool, and InnerSource are trademarks of PC Power & Cooling, Inc. All other brand names are trademarks or registered trademarks of their respective companies.



OS/2

*In Canada, call 1-800-465-7999. IBM and OS/2 are registered trademarks and OS/2 Crash Protection is a trademark of International Business Machines Corporation. Windows is a trademark of Microsoft Corporation. Adobe Type Manager is a registered trademark of Adobe Systems Incorporated. ©1992 IBM Corp.

With OS/2 2.0, you won't need one of these.

If you run more than one application at a time with DOS and Windows,[™] brace yourself. When one application fails, the entire system can fail. It's called a crash, but most people call it worse than that. Because each time it happens, you have to reboot your computer. If you didn't save what you were working on, you simply have to do it again. So every crash could be a huge crush. And a huge waste of time.

OS/2[®] 2.0 is different, because OS/2 Crash Protection[™] helps shield applications from each other. In other words, each running application is self-contained, so if one goes down it won't affect the others or the operating system. No frequent systemwide crashes like in Windows. So you won't lose all your valuable work. Not to mention time. And OS/2 can also save you money, because for less than the cost of DOS and Windows, you get the capabilities of both. Plus all the added benefits of OS/2 2.0—including Adobe Type Manager[®].

OS/2 2.0 lets you work like you never could before. And OS/2 Crash Protection helps keep it all from coming to a crashing halt. For an IBM authorized dealer near you, or to order OS/2 2.0 from IBM, call 1 800 3-IBM-OS2.*



Introducing OS/2 Crash Protection.

- Runs DOS, Windows and OS/2 applications from a single system.
- OS/2 Crash Protection helps shield applications from each other.
- No need to reboot your computer if an application fails.
- Supported on most IBM-compatible 386 SX PCs and above.
- To order OS/2 2.0, call 1 800 3-IBM-OS2.



LANtastic Merges PCs and Macs

In this election year, it's not difficult to compare Mac and PC users to the major U.S. political parties. All have their strong (often conflicting) opinions on "platforms" and applications, and getting them to work together is often virtually impossible. Still, in this Age of Connectivity, there's a real need for Mac and PC users to share files, applications, and resources through those ubiquitous LANs.

Mac-to-PC connectivity has been available for some time, but for those who wanted to go beyond simple, low-cost solutions (e.g., Traveling Software's LapLink Mac), the cost of truly networking these disparate platforms has been a budget buster. Until now, that is. Leave it to Artisoft to find a solution. The company's powerful yet inexpensive LANtastic network operating system has taken the lion's share of the PC peer-to-peer market. And now, with **LANtastic for Macintosh**, Artisoft has blasted its way into the Mac-to-PC connectivity market with a product that is destined to get Mac and PC users talking again.

Artisoft's product is a unique blend of conventional and unconventional technology. To start off, you will need one or more Macs. On that side of the network, things are simplified immensely by the fact that Macs already have a built-in network; LANtastic for Mac works with all varieties, whether you use the default LocalTalk or opt for adding the faster (and more expensive) EtherTalk or TokenTalk. On the other side, you'll need one or more PCs running LANtastic 4.0.

To tie the two sides of the network together, you'll need a *gateway server*. The heart of LANtastic for Mac is a dedicated PC that sits between your Macs and PCs, acting as the translator between the two worlds. A gateway PC isn't an unusual approach, and with the price of PCs continually falling, it's not an unreasonable expense.

Although the gateway server can be just about any flavor of PC, it's best to choose a system with as hefty a hard drive as you can afford. That's because the gateway server acts as a central repository of files for the network.

A bit of explanation is in order: Because LANtastic for Mac costs orders of mag-

nitude less than other Mac-to-PC solutions, there are, of course, a few compromises. The major one is that, while Macs on the network can read files off both the gateway server and any PC that's set up as a LANtastic server, PCs can't read files directly off Macs. PCs can, however, read Mac files stored on the gateway server. Therefore, if you want to do lots of file sharing, a large hard drive on the gateway server can pay dividends.

The major work of setting up LANtastic is in setting up the gateway server. I used a 386SX-based system with a 380-MB hard drive. I installed a standard LANtastic AE-3 Ethernet card and software, configuring it as a server on my small LAN of four PCs. The next step was to install the Farallon LocalTalk card (included with LANtastic for Mac) into the gateway server and connect it to my Mac IIx using the supplied PhoneNet cables.

I then installed the LANtastic for Mac software on the gateway server; this is where user accounts and resources are configured. Like any network, this one requires a bit of planning. One important part of the process is *file extension mapping*, enabling Macs to display PC files as icons on the Desktop. Most common applications and data-file types come with default icons, but you can also set up new ones.

I also set up the printer resources. One thing to note: Although PCs can't directly access files off Macs on the network, any Mac or PC can access any printer connected to any computer on either side of the gateway server.

Over on the Mac side, all I had to do was make sure the AppleShare icon was installed in the Extensions folder of my

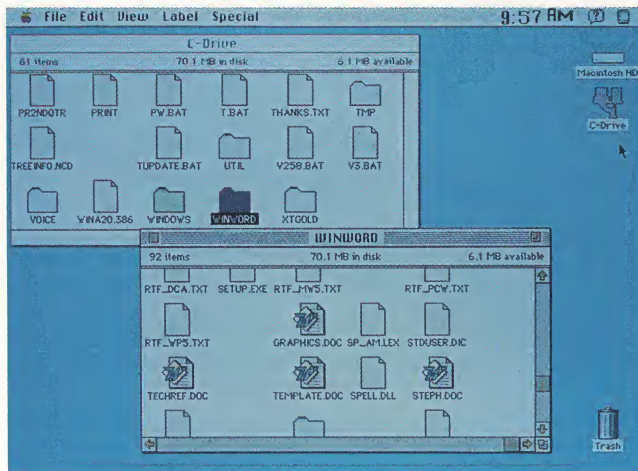
Mac (running System 7.0). There is LAN Mac Manager software that lets you administer the gateway server from the Mac side, but it's optional.

Setting up LANtastic for Mac is actually less complicated than it sounds. Once up and running, it works flawlessly and transparently. It's particularly useful in this era of Mac and PC applications with compatible file formats. I was able to work with Microsoft Word and Excel, Aldus PageMaker, and Claris FileMaker files from both the Mac and PC sides, with the compatible data file sitting on the gateway server.

LANtastic for Mac has extensive configurable security. Besides password login (with optional expiration) to the server, file and directory access can be controlled, and there's an audit trail for all users.

With a price that can't be beat, LANtastic for Macintosh is an easy-to-set-up and easy-to-use solution for anyone who wants Macs and PCs to communicate on equal terms. If only politicians could do the same.

—Stan Miastkowski



THE FACTS

LANtastic for Macintosh
with LocalTalk card for PC server,
\$799; software only, \$599

System requirements:

Any Mac with System 6.0 or higher, AppleShare Phase 2 workstation software, LocalTalk network, or EtherTalk or TokenTalk network adapter. Gateway server: PC with hard drive, LANtastic 4.0 or higher, LANtastic-compatible network adapter card, and AppleTalk adapter card (LocalTalk card included). PC servers: PC running LANtastic 4.0 or higher.

Artisoft, Inc.
691 East River Rd.
Tucson, AZ 85704
(800) 846-9726
(602) 293-4000
fax: (602) 293-8065

Circle 1082 on Inquiry Card.

THIS IS AN 855-FOOT, 70,000-TON NODE ON A NETWORK IN MIAMI.

Carnival Cruise Lines chose Remote LAN Node™ to connect their Miami-based LAN to their remote offices – ships at sea – for a simple reason: In their words, remote users “all get transparent access, just as though they were here at corporate.”

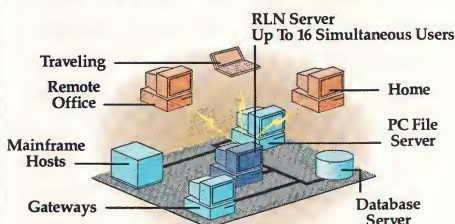
THIS IS A SIMPLE ILLUSTRATION OF HOW REMOTE LAN NODE WORKS.



RLN™ is a unique, economical software solution that *BYTE Magazine* said “comes closest to running an Ethernet cable directly from site to site.” (In a way, you can think of it as a software implementation of a network interface card.) And, as *BYTE* continued, it “eliminates the performance bottlenecks of remote-control packages and the protocol dependence of LAN-aware modems.”

RLN gives your network users the freedom to work anywhere, transparently, without losing network functionality.

THIS IS A SLIGHTLY MORE COMPLEX ONE.



RLN lets up to 16 remote users dial in at once and become nodes on your Ethernet network.

You can access any network protocol, such as IPX/SPX, TCP/IP,

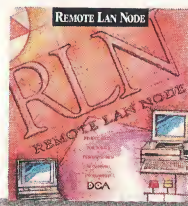
SPP/IPC, OSI and NetBEUI – or any interconnected combination. So RLN is compatible with virtually any network operating system.

You only dedicate one CPU for 16 simultaneous users, making RLN extremely cost-effective. Since applications reside on the remote PC, RLN makes running Windows™ remotely a reality. And you can protect your network with our optional Remote Security Adapter.

THIS IS A SIMPLE WAY TO TRY IT OUT.

Just call our European fulfillment center in the UK on (44) (0) 256 381102 or fax on

(44) (0) 256 381108 to order a demon-



stration diskette or our White Paper “Extending Your Network To Remote Users.” You’ll discover, as Carnival Cruise Lines did, that no matter how remote a PC may be, it can still be a full LAN node.

THE FREEDOM
TO COMMUNICATE.

DCA®

©1992 Digital Communications Associates, Inc. All rights reserved. DCA is a registered trademark of Digital Communications Associates, Inc. Remote LAN Node and RLN are trademarks of Intercomputer Communications Corp. Windows is a trademark of Microsoft Corporation. All other brand and product names are trademarks or registered trademarks of their respective owners.

INTRODUCING COLOR THAT GETS ALONG SW



Now the software you always work with can produce the color you've always dreamed of.

That's because the Canon CJ10 Color Bubble-Jet™ Copier is compatible with virtually all the Macintosh® and Windows® software* from leading manufacturers, such as Aldus®, Lotus®, Adobe,™ Microsoft,® WordPerfect,® Micro-

grafx,® you name it.

But it's not just software compatibility that makes the CJ10 so extraordinary. It's color. The same vivid color and crisp, clear, black text that made our Color Laser Copiers the industry standard.

Whether you need to scan, print or simply produce photographic-quality, full-color copies,

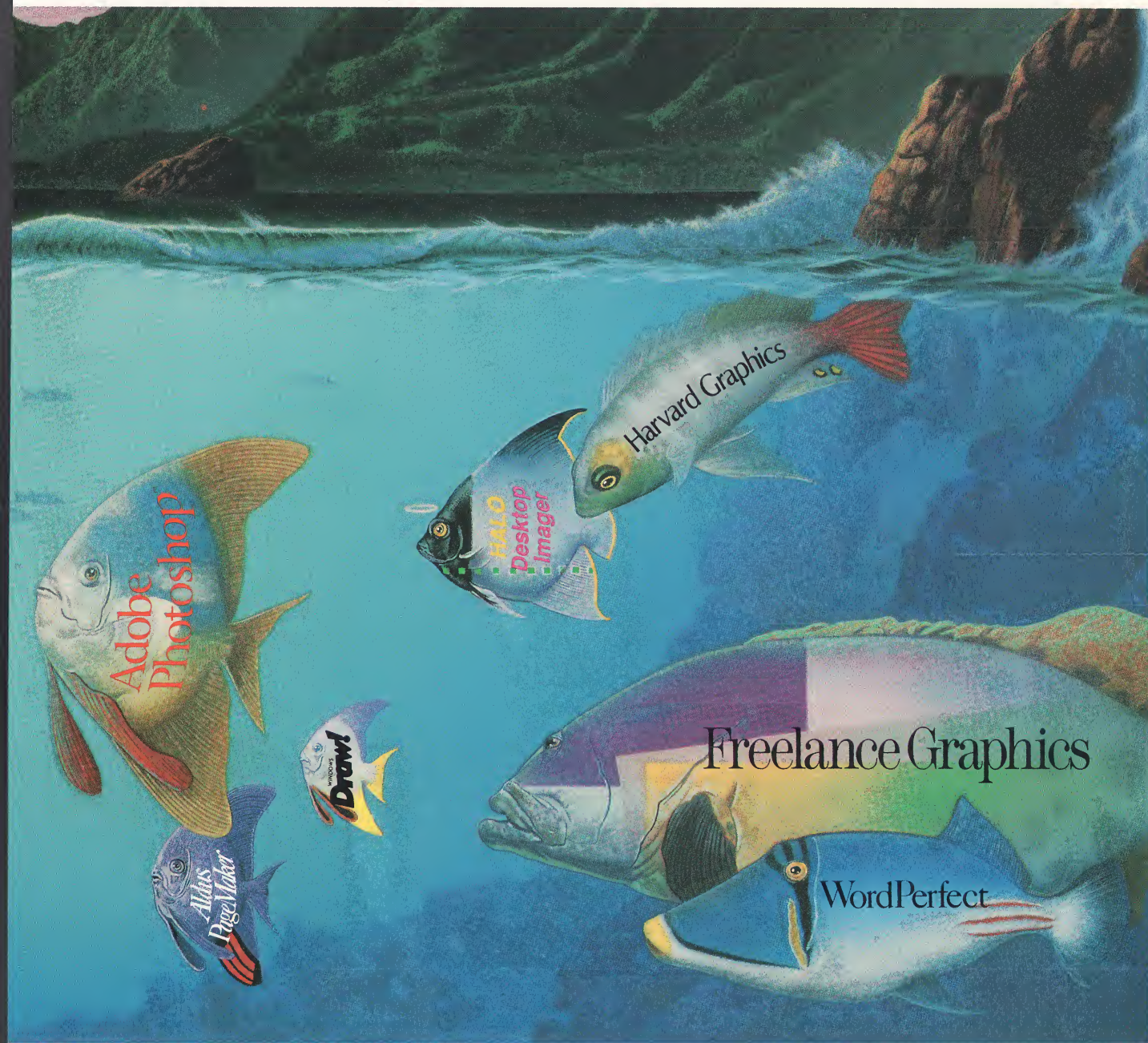
the CJ10 brings the power and vitality of color to your favorite desktop applications at a surprisingly affordable price.

For even more versatility, Canon has developed Windows and QuickDraw® printing and scanning drivers for the CJ10. And with third party software products, the CJ10 becomes a PostScript™ language

*Requires IPU SS and CJ10 IPU Kit.

All trademarks are property of their registered owners. Canon is a registered trademark and Bubble-Jet is a trademark of Canon, Inc. Macintosh and QuickDraw are registered trademarks of Apple Computer, Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. Aldus is a registered trademark of Aldus Corporation.

INGLY WITH ALL YOUR FAVORITE SOFTWARE.



compatible printer. So no matter what you want to create — documents, presentations, newsletters, transparencies and more, you have all the tools you need right at your fingertips.

Superior color, wide-ranging software compatibility and a very affordable price. It's an unbeatable — and unprecedented — combination that can turn your desktop



into a powerful business resource.

The Canon C110 Color Bubble-Jet Copier. It's a wise investment for your brightest ideas.

For more information simply call 1-800-OK-CANON.

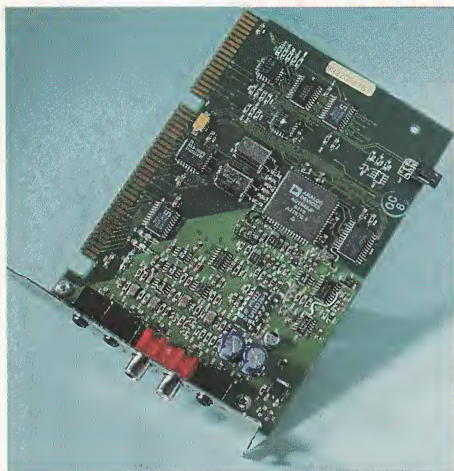
See us at Comdex Booth #1658.

Canon

Lotus is a registered trademark of Lotus Development Corporation. Adobe and PostScript are registered trademarks of Adobe Systems, Inc. WordPerfect is a registered trademark of WordPerfect Corporation. ZSoft is a trademark of ZSoft Corporation. Micrografx is a registered trademark of Micrografx, Inc. Freedom of Press is a registered trademark of Custom Applications, Inc.

Circle 249 on Inquiry Card.

Microsoft Windows Sound System



Microsoft, which legitimized the "serious" business use of PC sound boards with its release of Windows 3.1 and the Multimedia Extensions, has now decided to carve itself a slice of the sound-

board pie. The Microsoft **Windows Sound System** is a windy name for a small and sparsely populated board (see the photo). On the surface, compared to other sound boards, this one seems to come up short by virtue of the things it *doesn't* do: You'll find no CD-ROM controller, no Sound Blaster or AdLib compatibility, no external MIDI port, and no big bundle of standard software. But the Windows Sound System is a moderately priced board bundled with unique, useful software tools.

Of all the sound boards I've looked at, this one is the easiest to install. A single jumper on the board let me select a port address. When I fired up the Windows-based setup program from the installation floppy disk, a dialog box popped up to tell me that the board's interrupt had been reconfigured automatically because of a conflict. That's how I like things to work.

Once the board is in, making the back-panel connections is a breeze. In keeping with Microsoft's current icon madness,

the ports on the back of the board are labeled with symbols. It has 1/8-inch stereo jacks for a microphone (included), headphones (also included), and line input (for external devices like tape recorders). The headphone jack doubles as a line or speaker output, and Microsoft adds twin RCA line-output jacks for direct connection to speakers or to some devices' line input. Once the board is installed, everything about it is software-controlled.

The flagship application bundled with the board is called Quick Recorder. The name is a little deceptive; this is actually a capable sound editor that doubles as an OLE server. Quick Recorder employs an interface trick I haven't seen from Microsoft before: normal and expanded interface views. In normal view, only the minimum required controls and feedback are presented in a compact window. You can record, play, load, and save sound files, but you can't edit them. Expanded view brings up a more complex interface, with

Add-In/Add-On

ATI Graphics Ultra 1MB	330
Digichannel PC 8-port	375
Fahrenheit 1280 - 1MB	295
Hercules Gold 16/24	340/433
with 2MB	460/555
Logitech Mouseman Serial	55
Scanman 256	275
Matrox Hiper VGA	525
Mitsumi CD-ROM Kit	230
Mouse with Windows 3.1	70
Multimedia Upgrade Kit	555
Mylex GLE911	340
Mylex GXE020B	1050
NEC CD-Gallery	575
Paradise Win Accelerator	215
Proaudio Spectrum 16	200
Prodesigner II-S 1MB	185
Soundblaster Pro	195
Stealth VRAM	245
Volante AT1000/AT1200	720/1200

CAD & Graphics

Autocad Rel 11 & 12	CALL
Calcomp Digitizer/Plotter	CALL
Corel Draw	380
Design CAD 2D/3D	175/240
Drafix CAD for Windows	430
Microtek 600G/600Z	785/1350
Nunomics GraphicMaster	CALL
Summasketch	CALL
VynCAD	600
Xerox GS+ Scanner AT	1360

Chips & Memory

All Upgrades - ALR, AST, Apple, Compaq, DEC, Epson, HP, IBM, Silicon Gr, Sun, Toshiba	
387SX-20/25	105/115
387DX - 33/40	170/200
SIMM 1MB/4MB 70ns	30/125
ALL CHIPS AND SIMMS	CALL
HP Laser 2MB/4MB	120/200

Windows Accelerator S3 Hicolor 80mhz . . . \$235

P2000 Accelerator Truecolor 16M color . . . \$240

COMPUTER QUICK

Computers

ALR	CALL
Apple	CALL
AST	CALL
COMPAQ	CALL
Everex	CALL
IBM	CALL
NEC	CALL

ALL LAPTOPS AVAILABLE

Controllers

Adaptec 1542B/1740	260/460
DPT Smartcache EISA/SCSI	575
IDE caching with 4.5MB	550
Mylex EISA/SCSI cache	660
Ultrastor IDE cache	200
Ultrastor EISA/SCSI cache	450

Database

Clarion Pro Developer	450
Clipper 5.01	495
Database 4.5	525
DBase IV/Developers	489/839
Foxpro Single/LAN	469/565
Oracle V6	1100
Paradox 3.5 Upgrade	175
Rbase 4	465
Superbase 4 for Windows	460

Disk Drives

Seagate 351AX	175
Conner/Maxtor 60MB	195
Conner/Maxtor 80MB	210
Conner/Maxtor 120MB	290
Quantum 123MB 15ms	360
Conner 170MB	340
Quantum 245MB	650
Conner/Maxtor 340	790
Conner 543MB	1000
Maxtor 675MB	1200
Maxtor 1.5/1.7GB	1600/2100
Micropolis 668MB	1380
Syquest 44/80MB	CALL
Pinnacle 130S AT	1800
CD-ROM - Optical - WORM	CALL

Modem/FAX

Modems for all portables	LOW
Modem 2400 internal	55
FAX 9600 & Modem 2400	85
Faxit for Windows	85
Hayes Ultra 96	600
Intel FAX !New Version!	395
Pocket FAX96/Modem24	150
SupraFaxmodem9696 Extl	300
USR 16.8 External	600
USR V.32/V.42Int/Ext	555/606
USR Dual 16.8 Int/Ext	765/795

Software

Desqview 2.2/386/K	75/130/150
MS DOS 3.3/4.01/5.0	40
IBM OS/2 2.0	128
IBM OS/2 Extensions 2.0	450
XENIX/UNIX	CALL
Windows 3.1 Upgrade	55
Windows 3.1 + Mouse	75
ALL SOFTWARE - WE HAVE EVERYTHING!	

Tape Backup

Colorado 250MB	265
HP DAT Tape Backup	
2/5GB	1225/1370
Irwin A120/A250	185/245
Irwin A250 EP	645
Software for DOS/UNIX/LAN	

**18,000 Items
Price Diskette**

Shipped with order

Networking

3COM Etherlink 2 5-pack	800
AST 5251-11 Enh Plus	515
DLINK Pocket Ethernet	225
Everex Ethernet 8/16	87/135
IBM 3270 Used/New	225/410
IBM 5250 AT/MC	495
IBM Token Ring 16/4	630
Intel EtherExpress 20pak	2230
Intel Netport	495
IRMA 3	435
LANFax for Windows	CALL
Lantronic 10MB Starter	485
Lantronic AI Node	60
Mylex EISA Ethernet	309
NE-1000 5-pack	580
NE-2000 5-pack	715
NE-2100	155
NE-3200 EISA	665
Network Lite	70
Novell Netware	CALL
Shiva Netmodem 9600	1020
SMC Ethernet Elite 6-pack	650
Elite 16 6-pack	825
Elite MC	216
Elite 32	650
Thomas Conrad 16-bit fiber card	735
8-port fiber hub	1550

USED IBM !!LOW!!

Quantity & Dealer Discounts

PHONE: (415) 861-8330

Espanol (415) 861-8376

FAX: (415) 861-8380

Computer Quick, 165 - 8th Street, No. 309
San Francisco, CA 94103, USA

Upgradable Mother Boards for IBM-AT and Compaq 286, 286e

YOUR BEST CONTACT IN NORTH AMERICA



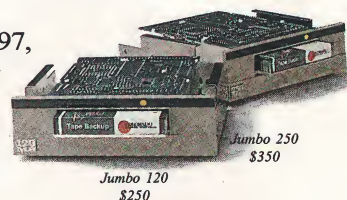
Two-time winner. All-time price leader.



JUMBO HAS DONE IT AGAIN

For two years in a row, the readers of Systems Integration Magazine have voted Jumbo "Product of the Year" in its tape/cartridge drive category. Which means Jumbo continues to be the first choice in tape backup. And now, at \$250, it's also the price leader. In poll after poll, Jumbo has taken top honors... in virtually every category. From value and ease of installation to

ease of use, data reliability and customer support. With backing like this, you can't go wrong. So choose either Jumbo 120 (120 MB with data compression) or Jumbo 250 (250 MB with data compression). Both give you QIC compatibility, Novell® Certification and UNIX®/Xenix® support. Call 1-800-451-0897, ext. 155 today for a free brochure.



full editing and effects capabilities.

The digital audio section of the Windows Sound System records and plays digital audio files at a maximum rate of 44.1 kHz in 16-bit stereo. Unique is the availability of a 4-bit compressed format in addition to the 8- and 16-bit formats. The

compressed format can be used even at the 44.1-kHz rate to reduce space requirements to the equivalent of those for 22-kHz audio. I found no significant difference between 4-bit compressed and 8-bit uncompressed audio digitized at the same rate.

The Sound System board sounds wonderful, and in my tests it recorded and produced clean, undistorted audio at the 44.1-kHz rate in 4-, 8-, and 16-bit resolutions. The lower rates were less impressive, as you'd expect, but passable.

Even though there are no external MIDI connections, the Windows Sound System includes a Yamaha OPL3 four-operator FM synthesizer. FM is the most prevalent synthesizer in audio boards, but it's a bit of a mismatch here: With the board capable of reproducing such high-quality digital audio, I wonder why Microsoft chose such a cheap-sounding synthesizer chip (most of Microsoft's competitors made the same mistake). Don't expect great-sounding music from this board.

The Windows Sound System includes a voice-recognition module. A Windows application sits in the background and listens to the microphone, waiting for voice commands. Each command set links command words and phrases with Windows keystroke macros. The idea is that you can run your computer, to a degree, by talking to it. Want to find out how much memory you have available? Just say "about Program Manager" into the microphone, and up it pops.

Everything is user-customizable, but a standard configuration is included that supposedly recognizes a limited number of commands without requiring training for a particular user's voice. The prerelease version I used required training before it would do *anything*, but after I learned to use the same inflection every time I spoke, it worked some of the time. Perhaps this will improve in the shipping version.

Overall, I give the Windows Sound System high marks. Its ease of installation, excellent software, and superb digital audio quality make it a worthwhile, though late, entry in the Windows sound-card race.

—Tom Yager

PUT AN END TO SOFTWARE PIRACY!

Meet the growing family of security keys from Software Security.

Each one a specialist at enforcing your license agreement in virtually any user environment you can think of. Whether it's DOS, UNIX, Macintosh or OS/2. Whether it's a single user installation or a LAN.

Simply connect the appropriate key to a single user computer, or a non-dedicated file server in a network, and you control all access to your protected application.

Users, however, won't even know it's there. The keys are transparent and won't impact software functionality or the ability to make back-up copies. Normal node and LAN operations are unaffected.

Simple. Unassuming. Ever vigilant. Easy to incorporate into your application package. And quite possibly the most profitable hardware investment a software developer can make.

To find out more, call:

1-800-841-1316

IN CONNECTICUT CALL: 203-329-8870

FAX 203-329-7428

EUROPE AND UK: +44 784 43 00 60



SOFTWARE SECURITY INC.

1011 High Ridge Road
Stamford, CT 06905

Proudly Made in the USA

The Ultimate Protection For Software Publishers

**NOW AVAILABLE!
NETWORK
PROTECTION
WITH REMOTE
UPDATING!**

Please see us at
COMDEX/Fall
Booth #H8244

All product names are trademarks or registered trademarks of their respective holders. Made in U.S.A.



THE FACTS

Windows Sound System
(price unavailable at press time)

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(206) 882-8080
fax: (206) 936-7329
Circle 1081 on Inquiry Card.

Programmer's Paradise®

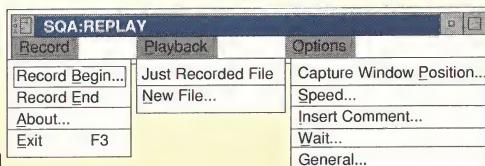
Presents

SQA: REPLAY FOR OS/2

See us at
COMDEX!
Booth# H7442

Special
Introductory
Offer!

The **first** macro record tool for OS/2, SQA:Replay helps you automate your OS/2 desktop. With a simple point and click, SQA:Replay begins recording your every keystroke, mouse movement and mouse click. You can save your recording for playback at a later time. Use SQA:Replay to automate report writing, database queries, mailings, anything you currently do manually with your OS/2 applications!



Advanced Recording Technology

- **Graphical Interface** - Easy to use with no programming necessary. Just "point and click" to start your recording.
- **Click and Forget** - Captures all of your activity (keyboard and mouse) without interfering with your application or the way you normally work.
- **Full Screen or Windows** - Works in full-screen character mode or with Presentation Manager windows.

Flexible Replay

- **Window Repositioning** - Automatically puts your desktop back in order before replay begins.
- **Variable Speed** - You select the speed at which you wish to playback your recording.
- **Wait States** - Ask SQA:Replay to selectively pause during playback, based upon window existence or dialog.
- **Unattended Playback** - Playback your recordings during the night or anytime you are away from your PC.

Additional Features

- **Dual Versions** - Works with OS/2 1.3 or OS/2 2.0.
- **"Hide/Unide"** - Hotkey displays SQA:Replay options menu or puts it away when you want a clear desktop.

Upgrade to SQA:Robot

- SQA:Replay is the only macro recording software that is upgradeable to a full-featured test regression tool. Your SQA:Replay scripts can be used by SQA:Robot to test any OS/2 application.

System Requirements

- IBM AT/PS/2 (286 and up) or 100% compatibles
- OS/2 1.3 or higher
- 2 MB free disk space for installation
- Mouse recommended

\$79

(While supplies last)
ORDER TODAY!

To order call:

Programmer's Paradise®
1-800-445-7899

SoftwareQualityAutomation
1 Parker Street
Lawrence, MA 01843
1-508-689-0182



OS/2 is a registered trademark of International Business Machines.
SQA, SQA:Replay, and SQA:Robot are registered trademarks of
Software Quality Automation.

SQA's 30-day Money Back Guarantee: If you are not satisfied with this SQA product, return it to your dealer for a full refund.

Call Programmer's Paradise® Today!
And mention this ad when placing your order!

1-800-445-7899
Corporate: 800-422-6507
(CORSOFT Division)

Programmer's The Software Sour

Developers, we're here to serve you. Programmer's Paradise offers the world's largest selection of software development tools and utilities at guaranteed low prices. If you don't see what you want, call us! And don't forget to ask for our free comprehensive catalog.

METAWARE HIGH C/C++

MetaWare Inc. announces its newest product. The 32-bit High C/C++ compiler version 3.0 is a true compiler, not a C to C++ translator. "Incremental Strengths" lets you specify the level of C++ compilation, allowing you to migrate from C to C++ one C++ block at a time. Included in this package is a C++-tailored source-level debugger and a 32-bit Application Development Kit for Windows. MetaWare offers a full line of multi-language, multi-platform compilers for professional software developers.

List: \$795 Ours: \$669
FAXcetera #1590-0008



386/486 Development

Intel 386/486 C Code Builder	575
Lahey EM/32 5.0	1015
MetaWare High C/C++	669
Phar Lap 386DOS-Extender	435
Prof. Pascal Ext. DOS	749
SVS Products	CALL
WATCOM C9.0/386	599
Zortech C++ Devel. 3.0	445

Basic

Dazzle/VB	269
GFA Basic for Windows	235
MS Basic PDS	349
ProBas 5.0	169
Q+E Database/VB	CALL
Realizer	CALL
Visual Basic/Win	139
Visual Basic & Tkt Bundle	228
Visual Basic for DOS	139
Professional	325
Competitive Upgrade	CALL

C/C++ Compilers

Borland C++	319
w/Apl. Frameworks	539
High C/C++	CALL
Microsoft C/C++ 7.0	325
MS QuickC for Windows	139
Turbo C++	69
for Windows	112

C-Application Generators

CASE:W Corporate	CALL
dANALYST GOLD	89
PRO-C	99
WindowsMAKER Prof.	695



NEW VERSION! Next generation of industry standard C/C++ development tool for Windows. The easiest, fastest way to create Windows apps, just point and click. New architecture uses Switch-It™ Code Generation Modules for generating ANSI C, MFC C++ or OWL C++ code, among others. Award-winning Visual Prototyper lets you test the look & feel and make changes on the fly. TrueCode technology ensures that user code is preserved during code regeneration. Generates Windows .EXE w/fully commented C or C++ source. CUA & SAA compliant.

List: \$995 Ours: \$695
FAXcetera #2602-0003

Dan Bricklin's Demo II

Experience for yourself why 30,000 people have made Demo II 3.0 the leading tool for producing program prototypes, demonstrations, and tutorials. Demonstrate commercial software to potential customers without shipping live software. Produce effective tutorials that interactively teach products. Create Computer Based Training for a fraction of the cost of dedicated CBT authoring software.

List: \$249 Ours: \$215
FAXcetera #0233-0003



C Communications

BreakOut II	225
C Asynch Manager	175
C Comm Toolkit	139
Essential Comm	295
Greenleaf CommLib	339
Greenleaf ViewComm	319
QuickComm	119
SilverComm C Async	195

C Screens

C-scape	449
C Windows Toolkit 386	179
Greenleaf Data Windows	335
Instant Windows	419
Island Pro Pak	489
QuickWindows Advanced	119
VC Screen	125
Vitamin C	339

Microsoft Visual Basic for DOS

Award-winning productivity—now available for DOS! Draw forms and controls, write event-procedures, use and create custom controls—in DOS! Create all-new apps or combine with existing C/C++ or Pascal code. Highly compatible with VB/Win for multi-platform development. Even run existing MS Quick Basic/Basic PDS code! Includes a native 80x86 compiler that creates 100% standalone .EXE files, 386 code generation, MOVE overlays, an integrated ISAM and much more!

List: \$495 Ours: \$325
FAXcetera #1269-0039



PRODUCT OF THE MONTH:

WindowsMAKER Professional 4.0

C- Additional Products

C-Doc	170
C-Doc Professional	269
MKS LEX & YACC	199
PC Lint	99
Phar Lap 286DOS-Extender	435

C++ Libraries/Utilities

C++Views	449
Codebase 4.5	295
Greenleaf Comm++	169
KPWIn++	CALL
Object-Menu	269
Object Professional for C++	199
Poet	369
Rogue Wave Math.h++	269
Rogue Wave Tools.h++	269
Style	199
Win++	185
Zinc 3.0	399

International: 908-389-9228
Customer Service: 908-389-9229

Canada: 800-445-7899
Fax: 908-389-9227

CALL US

Paradise[®] ce for Developers!

See us at
COMDEX!
Booth# H7442

Database Development

Clarion Prof.	449
Clipper	499
DataBoss 3.5	CALL
dBASE IV	569
FoxPro	489
FoxPro Competitive Upg.	CALL
FoxPro Distribution Kit	CALL
Paradox 3.5	569
Q+E Database Library	279
R&R Code Generator	179
SilverClip/Fox SPCS	239
WATCOM SQL/Dev. Edit.	CALL
Network Server Edition	CALL

Pascal

Topaz	89
Turbo Pascal for Windows	112
Turbo Pascal Professional	225
Turbo Professional	109
Prototyping	
Dan Bricklin's Demo II	215
Show Partner F/X	315
Version Control	
MKS RCS	CALL
Sourcerer's Apprentice	CALL
SourceSafe	199
TLIB	125

Utilities

386MAX	72
After Dark	32
Bar Code Library	350
Blue MAX	91
Dr. Switch-ASE	159
DVT (Data Vis. Tool)	CALL
HIJAACK	189
Hold Everything	179
Iconic/Query	219
INSTALIT	119
Label Master	429
MKS Toolkit	199
Norton Anti-Virus	99
Norton Commander	99
Norton Utilities 6.0	119
Opt-Tech Sort/Merge	119
PC Tools Deluxe 7.0	129
QEMM 386	68
SpinRite II	59
UpShot	139

Buy KPWin++ – Get Microsoft C/C++ 7.0 FREE!

Don't code in C++. Let KPWin++ do it for you! KPWin is a high-level, full-featured OOP language for Windows. Design screens visually, add logic, hypertext, multimedia and expert systems functions, then use KPWin++ to translate your KPWin code, DDE and low-level DLL calls into readable, efficient, object-oriented C++. Add-ins available for SQL and Motion Video.



KPWin++
Microsoft C/C++ 7.0
Total Value
FAXcetera #1474-0007

List: \$895 Ours: \$799
List: \$499 Ours: FREE
List: \$1394 Ours: \$799

"Domestic sales only"

MKS Learning UNIX Package



MKS Learning Package is a complete learning kit for DOS users. Learning is easy with introductory tutorials and exercises. This hands on book and disk set unveils UNIX concepts like the file system, and shell programming on your PC. You can do as you learn, and get a solid start towards working on a real UNIX system.

List: \$179 Ours: \$149
FAXcetera #1634-0011

GUARANTEED BEST PRICES*

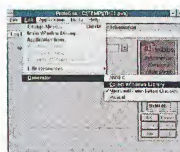
Should you see one of these products listed at a lower price in another ad in this magazine, **CALL US!** We'll match the price, and still offer our same quality service and support!

Terms of offer:

- * Offer good through November 30, 1992 *
- * Applicable to pricing on current versions of software listed.
- * November issue prices only.
- * Offer does not apply towards obvious errors in competitors' ads.
- * Subject to same terms and conditions

ProtoGen 3.0

NEW VERSION! The industry standard for code generation and prototyping Windows application. Develop the user interface of your application using Visual prototyping methods. ProtoGen generates expert level, commented code for ANSI C, Microsoft MFC C++, Borland OWL C++, Turbo Pascal, and Microsoft NT Win32. All generators included! User Code is preserved from one generation to the next. It's easy and fast.



List: \$199 Ours: \$99
FAXcetera #2553-0002

Editors

Brief	179
ED NEW!	CALL
Multi Edit	89
Multi Edit Professional	139
SlickEdit	149
Vedit Plus	149

FORTRAN

Lahey F77-EM/32 5.0	1015
Lahey F77L	535
MS FORTRAN	315
WATCOM FORTRAN 779.0	449

Graphic Libraries

Baby Driver II	239
BLACKHAWK dGT	310
Essential Graphics GUI	135
Essential Graphics Kernal	179
Graf/Drive Plus Dev.	269
graphics-MENU	209
GX Effects 2.0	179
GX Graphics	224
GX Text 2.0	134
ICON-TOOLS	135
ImageMan	359
Menuet	319
NAPCAD/3D	79
PGL	179
TGL 2D, 3D	CALL
Victor Image Library	179

Linkers/Profilers

RTLink/Plus	445
Blinker	269
PLink86 +	335

Windows Development

C Comm Toolkit/Win	395
dBast Windows	349
InstallSHIELD	CALL
Kansmen Products	CALL
Magic Fields	CALL
MS Test	275
Norton Desktop 2.0/Win	CALL
ObjectVision	109
ProtoGen SPECIAL!	99
RoboHelp	449
Realizer	CALL
Smalltalk V/Windows	395
SQA: Robot	449
WindowsMAKER Prof.	695
Windows Teach	110

Phone Orders

Mon-Fri 8:30 AM-8PM EST, Sat 9:30-2:30 EST. We accept MC, Visa, AMEX. Domestic shipments, please add \$6 per item for shipping/handling. Items which weigh fifteen pounds or more will be charged at actual UPS ground rates. Domestic COD shipments, please add \$4. Rush service available.

Mail or FAX / International Orders/ Domestic Purchase Orders Phone number required.

Returns Subject to \$25 processing charge per product.

FAXcetera[®] (908) 389-8173 Call from your FAX telephone and follow the instructions to receive more information on the products featured above!

Corporate Accounts Call CORSOFT, our corporate sales division. Ask about volume purchase agreements.

* All prices subject to change without notice.

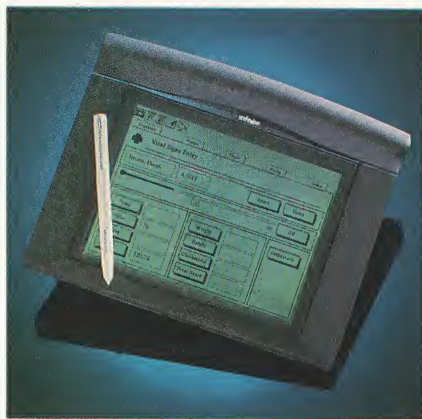
TODAY!

800-445-7899

CORPORATE (CORSOFT): 800 422-6507

CALL 800-445-7899

Infolio Offers Mobile Workers the Power of the Pen



While pen computer system vendors struggle to find a common thread in an embryonic market, PI Systems has struck out on a narrower path. One of the first things you notice when using PI's \$1895 **Infolio** is that it doesn't look much like a traditional computer. Rather than designing a notebook-style computer, PI started from scratch and built a deceptively simple yet effective electronic-clipboard type of tablet specifically for data collection tasks for mobile users. Using the Infolio is intuitive and requires little or no knowledge of computing, and nearly everyone I showed my test model to had a tough time letting go of it.

Infolio deviates from the pen-computing norm in its use of the Motorola 32-bit 16-MHz MC68331, which is more often encountered as an embedded microcontroller. Infolio also runs on PI's own internally developed object-oriented operating sys-

tem, PICOS, which the company says will link to other platforms in 1993.

One reason PI selected the 68331 was that it's a fully static part, allowing dynamic adjustment from 0 Hz (in Infolio's low-power stop mode) to 16 MHz. The 9.4- by 11.2- by 1.2-inch clipboard, which weighs 2.9 pounds (3.4 pounds with a battery pack of 8 AA nickel-cadmium or alkaline batteries), also has no floppy or hard drives; its use of solid-state storage rather than rotating media greatly contributes to low power consumption and brisk performance.

Of its three PCMCIA drive slots, Infolio uses the first for a 2-MB SRAM (static RAM) card containing its operating-system software; the other two slots are for storing additional data or programs. Infolio's microkernel uses only about 200 KB of memory; the entire system software requires 1 MB of memory. The clipboard also sports a Sharp reflective LCD with VGA-level 640- by 480-pixel resolution, and it uses an awake/sleep mode as well as an automatic shutdown mode, prolonging battery life up to a claimed 12 hours.

On powering up Infolio, I was greeted by a list of graphical menus representing forms-based vertical applications that mobile users typically would fill out in the course of their jobs. An example is PI's series of patient-care forms that hospitals would use to track patient billing records or treatment schedules.

My developer's edition of Infolio included a clipboard environment that had several extra utility programs (e.g., a calculator, address book, and memory usage monitor) organized in an electronic file-

folder format. At the discretion of developers, most Infolio users will probably not see those features, but they will be able to take advantage of PI's character-recognition system, which allows users to "train" the system to recognize their own printing, and its ability to capture cursive handwriting through electronic ink. PI will also sell a software developer's kit, called the ProformaSDK, that includes a graphical object-oriented applications development tool with an integrated database for developing applications for Infolio using Microsoft Windows-based PCs.

PI hopes to avoid the pitfalls encountered by highly touted but more horizontal pen-system companies. Given the 2-year-old start-up's narrow focus, PI just may be able to capitalize on early growth in pen systems long enough to stick around until the market takes off in earnest later in the decade.

—Patrick Waurzyniak

THE FACTS

Infolio

\$1895; ProformaSDK, \$1095

PI Systems Corp.
10300 Southwest Greenburg Rd.,
Suite 500
Portland, OR 97223
(503) 293-9585
fax: (503) 293-9590

Circle 1075 on Inquiry Card.

A Move Toward the Paperless Office

Okidata has coined the term *Desktop Document Processing* to describe **DOC.IT**, a printer, fax, scanner, and copier all in one. Okidata has tied all the parts and pieces of the everyday office into a neat package that features a well-integrated Windows application for controlling the hardware.

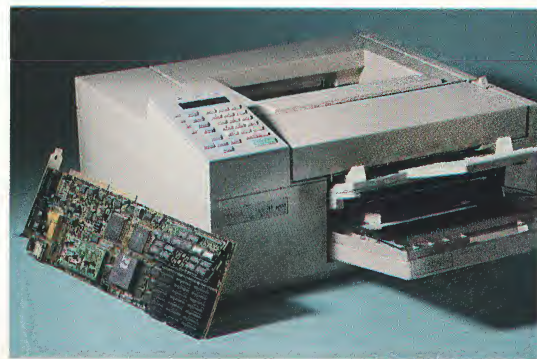
At the heart of DOC.IT is a dedicated add-in board with an Intel 960 RISC processor and 4 MB of its own RAM. The board takes the processing needs of document processing away from your system's CPU. It also communicates with the DOC.IT external hardware through a high-speed port. Because the board uses an in-

terrupt, a base I/O port, and a base memory address, configuring it is difficult. I recommend leaving this to your dealer.

The software, DOC.IT Manager, integrates all the individual abilities of the hardware and software through a command bar with 14 icons. It works with all your Windows applications and lets you print, copy, fax, or import scanned images.

One key feature is that each module works independently. But you still have to have the

add-in board installed and running before you can use any features. The independent



The Sound Choice In Multimedia Upgrade Kits.



If upgrading your PC to MPC standards sounds good to you, we can make it sound even better. With a multimedia upgrade kit from Creative Labs.

For only \$799, you get the only multimedia upgrade kit with Sound Blaster™ Pro, winner of the MULTIMEDIA WORLD Readers' Choice Award for "Best Sound Board." Experience true-to-life 8-bit stereo audio effects from applications and games. With MIDI adapter cable and sequencing software, plus a 20-voice, 4-operator FM music synthesizer, Sound Blaster Pro is one sound investment!

And that's only the beginning. There's a high-performance CD-ROM drive that surpasses MPC specifications. Plus a FREE library of CDs that will open your PC to all the possibilities of multimedia computing. Over \$3,000 worth of the hottest CD titles for multimedia authoring and enhanced education, entertainment, and

productivity capabilities for your computer.

You get Microsoft® Windows™ 3.1, Microsoft Bookshelf®, a reference resource with an encyclopedia, thesaurus, and dictionary. Microsoft Works for Windows™, an integrated productivity package. MacroMind® Action!™, Authorware® Star™ and Temptra™ from Mathematica, presentation tools for DOS and Windows. Sherlock Holmes, Consulting Detective, the award-winning mystery game. And many, many more.

The Sound Blaster Multimedia Upgrade Kit. At only \$799! To find out more, visit your computer retailer or call Creative Labs at 1-800-998-LABS.

And see why choosing our multimedia upgrade kit is the most sound decision you'll ever make.



Sound Blaster is a trademark of Creative Labs, Inc.
All other marks are owned by their respective companies. © 1992 Creative Labs, Inc. All rights reserved.
International inquiries: Creative Technology, Ltd., Singapore Tel 65-773-0233 Fax 65-773-0353



CREATIVE
CREATIVE LABS, INC.



COMDEX/Fall '92

**Sands Convention Center Booth #3222
Ballys MultiMedia Showcase Booth #B910**

Circle 227 on Inquiry Card.

functioning of the modules answers the question I always have about all-in-one hardware: What happens when one part or function breaks? With DOC.IT Manager, system functions operate independently. Another feature that makes this peripheral practical is a control panel that lets you make a copy or send a fax while the system is running other applications.

As for quality, it appears that Okidata hasn't cut corners here, either. The printer, copier, scanner, and fax functions operate at resolutions of 300 dots per inch and above. (DOC.IT is available in two models, with 300- or 400-dpi printer resolution.) The fax is CCITT Group 3, and the 8-page-per-minute printer has standard emulations such as PostScript-compatible TrueType and PCL 5.

You use DOC.IT by accessing pull-down menus on the DOC.IT Manager interface. When I wanted to scan an image, for example, I just selected the type of image, resolution, intensity, and page size

from the menu. I also had the choice of line art, number of gray levels, and half-tones. The scanned image was stored in TIFF format, and I had the choice of compressed, decompressed, and 200, 300, or 400 dpi. The scanner operates at 10 ppm and offers a 64-level gray scale.

The fax function works equally well, and I realized that the fax and scan functions would do the most toward freeing my office of multitudes of paper. Fax features include broadcast, delayed transmission, phone book with group lists, logs, and polling. The document-fed scanner can also be pulled out to be a hand scanner, for books and things that won't fit through the sheet feeder. One key feature that won't be available for a while is character recognition, which I consider essential for turning scanned paper into workable data.

I found DOC.IT a bit of a novelty, but only because it offers so many functions in a relatively small package. It measures 8.5 by 17.5 by 22.5 inches and weighs just 36

pounds. I can imagine a device like this becoming an indispensable part of a busy office environment, but the market may be a hard one to crack. After all, most offices already have a laser printer, scanner, copy machine, and fax. But for those users with individual document management needs, DOC.IT might suit them all.

—Anne Fischer Lent

THE FACTS

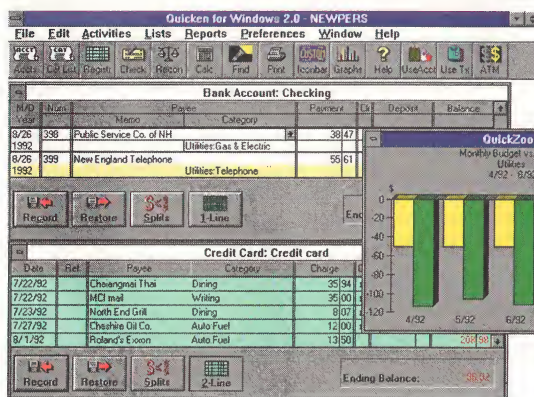
DOC.IT

DOC.IT 3000 (300 dpi), \$3999;
DOC.IT 4000 (400 dpi), \$4999

Okidata
532 Fellowship Rd.
Mount Laurel, NJ 08054
(609) 235-2600
fax: (609) 778-4184

Circle 1076 on Inquiry Card.

Personal Accounting: Quicken 2.0 for Windows



One of Quicken's strengths has always been its flexibility, and the beta of Intuit's new **Quicken 2.0 for Windows** that I looked at continues to demonstrate that trait. For example, the icon bar along the top of the screen (which automates standard actions) now lets you display icons, text, both, or neither. You can hide any buttons that you don't use, and you can add icons to automate transactions that you do often, open accounts that you use frequently, and implement a dozen other functions.

In the checkbook register-like transaction windows, you can now choose be-

tween two- or one-line entries. When you fill in the payee and category, new drop-down boxes let you choose names from a memorized list, and you can have those boxes appear automatically or by clicking a button—or choose not to have them appear at all.

Like the previous version, Quicken 2.0 for Windows has excellent standard and customizable reports, and now you can change, memorize, or print those reports using a series of buttons right on top of the report.

This is handier and more intuitive than having to traverse a bunch of menus.

New features include the ability to create customizable graphs of income and expense, budgets, net worth, and investments. Another new feature (and one that I found to be particularly useful) is QuickZoom, which lets you double-click on any data in a graph and get more details. One optional new service is IntelliCharge, which lets you reconcile your credit card statement automatically, by modem or on disk.

If the thought of setting up a budget scares you, you will like Quicken's new AutoCreate Budget option, which uses

your existing data to build a budget for you. The program also has a financial planning toolkit to help you plan for loans, retirement, college, and so on. In several places, a new feature called Qcards pops up to help you when you undertake a new task—it is a bit like the Mac's Balloon Help.

If you already use Quicken, you'll love this new version. If you don't use Quicken, you may want to give this intuitive financial program a look.

—Kenneth M. Sheldon

THE FACTS

Quicken 2.0 for Windows

\$69.95; upgrade for owners of previous versions, \$29.95

System requirements:
Windows 3.0 or higher; 2 MB of RAM.

Intuit, Inc.
155 Linfield Ave.
Menlo Park, CA 94026
(415) 322-0573

Circle 1077 on Inquiry Card.

VARBUSINESS
Spreadsheet Report Card 1992

	Average Score	Access Tech.	Computer Assoc's	Lotus	Microsoft
PRODUCT FEATURES					
Ease of use	7.01	6.70	7.00	6.81	7.52
Memory requirement	6.40	6.82	6.89	5.71	6.18
Ease of programming	6.48	6.33	6.58	6.32	6.69
Ability to manipulate data	7.35	7.60	7.29	7.00	7.52
Sorting capabilities	6.90	7.67	6.64	6.58	6.73
Provision for software security	5.65	5.87	5.67	5.32	5.75
Report writing capabilities	6.14	5.57	6.28	5.89	6.82
Ease of use of interface	6.82	6.75	6.70	6.18	7.63
Software integration capabilities	6.84	6.94	6.82	6.32	7.31
Ease of data retrieval	7.41	7.56	7.52	7.10	7.44
Satisfaction with product profitability	6.21	6.47	6.44	6.05	5.89
Overall quality of product	7.48	7.28	7.72	7.18	7.78
Product features average	6.73	6.80	6.80	6.37	6.94
SUPPORT FEATURES					
Provision for customer support	5.88	5.06	6.97	5.47	6.02
Charges for training time	5.17	4.38	5.95	5.05	5.29
Provision for technical support	5.76	5.20	6.60	5.40	5.85
Provision for marketing support	5.65	5.00	6.40	5.43	5.75
Documentation & product information	6.85	6.25	7.27	6.77	7.13
Frequency of updates & revisions	5.99	6.06	5.95	5.84	6.10
Support features average	5.88	5.33	6.52	5.66	6.02
OVERALL AVERAGE	6.45	6.31	6.71	6.13	6.63

Shockley of reseller Karma International. "On a cost-per-

for more users," says Ed

more needs to-

ment the Computer prod

more man Ed

res In

"C

fea than

is valu

and spre

The vide

exce

as co

In sw

tual

Supp

cata

Super

cored in the

area supp

uns

pro

ma

Tb

of

cober

tio

col

res

ica

for

sua

none

C

Ass

VARBUSINESS
March, 1992



CA-SuperCalc

Shouldn't you be using the spreadsheet that beat the big boys? CA-SuperCalc. Number One in number-crunching.

Free
Demo Disk

COMPUTER ASSOCIATES
Software superior by design.

A True-Color Combination



I'm a tough customer when it comes to evaluating 17-inch color monitors. After all, I have an NEC 5FG on my desk. Later, though, I've been using the **Optquest 4000D** hooked to a **HiColor Turbo F/X** video adapter from International Computers. And I like what I've been seeing.

The Optquest 4000D has all the amenities you look for in a large-screen monitor. It's noninterlaced and supports the new VESA (Video Electronics Standards Association) standard for refresh rates (72 Hz), resulting in a crisp, flicker-free display. The flat-screen design, coupled with an

etched surface, reduces glare; the antistatic coating reduces distortions caused by stray magnetic fields. Radiation emissions fall within the Swedish MPR II standards.

The 4000D's image quality is good: The monitor displayed sharp images and bright colors. I ran the full suite of DisplayMate video tests from Sonera Technologies, and the 4000D showed no serious image defects. But I've been spoiled: The Optquest monitor is no match for the NEC 5FG when it comes to image quality. It's hard to put a price on quality, but for my money, I'd need to save at least \$300 to turn away from the 5FG.

Given the high cost of large-screen monitors, the surprisingly low cost of high-resolution video adapters is downright ironic. The Turbo F/X from International Computers delivers 1280- by 1024-pixel resolution and up to 16 million colors for only \$159. The card uses the same Tseng Labs AT4000 chip that many other vendors ship with their video cards, but the Turbo F/X seems to pump some additional power out of the chip. With only 1 MB of video RAM, you can run at 1280- by 1024-pixel resolution with 16 colors, or you can enjoy 32,000 colors in 800- by 600-pixel resolution. Few cards can get those kinds of specifications from a single megabyte.

The card also performs well as a low-cost solution. On Texas Instruments' WinTach benchmarks, the adapter performed significantly better than the AT4000 sample listed by the program. If you want an inexpensive way to move up to true-color Windows, the Turbo F/X can get you there.

—Stanford Diehl

THE FACTS

Optquest 4000D
\$1495

Optquest, Inc.
9830 Albutis Ave.
Santa Fe Springs, CA 90670
(310) 948-1185
fax: (310) 949-2231

Circle 1078 on Inquiry Card.

HiColor Turbo F/X
\$159

International Computers
12021 West Bluemound Rd.
Wauwatosa, WI 53226
(800) 992-9000
(414) 764-9000

Circle 1079 on Inquiry Card.

Virtually Universal Text-Processing Possibilities

LONDON—**Ways for Windows** is a powerful system for automating Windows text-processing applications. A background program that filters all keyboard input to Windows, Ways can substitute words into the input stream in many ways. Its free-form, associative database engine uses fast word-similarity and cluster-analysis algorithms invented by its author, the Swiss mathematician Hannes Keller, which lets Ways analyze each word you type in real time (typically 0.1 second after you press the space bar). This allows Ways to do on-line spelling correction, abbreviation expansion, macro recording and playback, word-for-word foreign-language translation, thesaurus lookup, and much more. I saw Ways used to do a word-for-word English-to-German translation.

Ways takes about 10 MB of disk space. When running, it displays a long, thin window from whose Files menu you can load new dictionaries and then browse through

them manually. When you click on the Online box, Ways performs as-you-type spelling correction or translation using the current dictionary. Click on the Learn box, and Ways adds unfamiliar words to the dictionary as you type. Keller's correction algorithms are adaptive, so the spelling rules improve as a dictionary grows. When you click on the AutoType box, you activate Ways' dynamically created abbreviation dictionary. Thus, if I type the word *transputer*, whenever I type *tr*, *transputer* will be offered in the AutoType box.

Ways' thesaurus is pretty remarkable, too. It contains the usual lists of synonyms, but it also lets you attach a database record, a note, or an external text file to any item, or even run another Windows program.

All these facilities are available within any Windows program that accepts text input (e.g., the Notepad or Cardfile) and even on the entry line of file dialog boxes. Keller tells me he's scheduled to demon-

strate Ways to Microsoft executives, so this elegant software might find its way into a future version of Windows. ■

—Dick Pountain

THE FACTS

Ways for Windows
about \$200 (about 258 Swiss francs)

System requirements:

An IBM PC compatible with Microsoft Windows and 10 MB of free disk space.

Witch Systems AG.
Binzmühlestrasse 45
CH-8050 Zurich
Switzerland
41-1-311-6595

fax: 41-1-311-6540

Circle 1160 on Inquiry Card.

You Name It.

TAKE YOUR CHOICE OF DESKTOP, LAPTOP OR NOTEBOOK



16mm Trackball
adjacent to cursor keys

KEYBOARDS WITH INTEGRATED POINTING
DEVICES IN
AWARD-WINNING
DESIGNS.



25mm Trackball
above the LED



PORTABLE KEYBOARDS IN MULTIPLE LAYOUTS CUSTOMIZED FOR YOU.

AVAILABLE IN 35 LANGUAGES AND VIRTUALLY

LANGUAGES

You name it.

Demandez, vous l'aurez

**Sagen Sie uns,
was Sie brauchen**

Basta chiedere, e l'avrete

Usted dira

Слово за Вами!

Plus 29 others.



Custom
Colors

ANY COLOR OR
GRAPHICS.

MADE IN THE U.S.A.



Portable
Keyboards

We'll Make It.

Whatever kind of keyboards you need, Lexmark has your solution. Keyboards that are 101-key, 102-key, 84-key, 122-key or 84-key with detachable numpad. You name it. We'll make it. Deliver it on time. And back it up with unmatched technical support.

For more information and OEM pricing, call 1-800-777-4886; in Europe, call (33) 38 83 4308. Retail customers call 1-800-438-2468. To give your system a competitive edge, call us now!

Lexmark International, Inc., a former division of IBM®, is an independent worldwide company that develops, manufactures and markets IBM personal printers, IBM typewriters, related supplies and keyboards.

LEXMARK™

Make Your Mark

**Circle 228 on Inquiry Card
(RESELLERS: 229).**

See Us At COMDEX At Booth Number 1028

IBM is a registered trademark of International Business Machines Corporation in the United States and/or other countries, and used under license. PC Magazine Editors' Choice logo, ©1985 Ziff Communications Company. PC Magazine and PC Magazines Editors' Choice are registered trademarks of Ziff Communications Company. Lexmark is a trademark of Lexmark International, Inc. © Lexmark International, 1992.

Gaze into our windows and you'll see our high-

resolution 15" MultiSync® 4FG™ and 17"

MultiSync 5FG monitors* offer you spectacu-

Move up to bigger, brighter windows.

lar views. These monitors are ideal for display of windowing environments because they both feature a

large active display area with FullScan™ capability for bright, sharp, flicker-free edge-to-edge images.

Both are compatible with MS-DOS based systems and the Macintosh® II and Quadra™ family systems.

➔ And now if you buy a MultiSync 4FG or 5FG

by December 31, 1992, we'll give you a MultiSync monitor lens. Free. (\$79 value

for the 4FG/\$119 value for the 5FG.) The



MultiSync 5FG monitor



MultiSync 4FG monitor



MultiSync 4FG monitor
MacUser Magazine

monitor lens provides the perfect balance of contrast and brightness for use in poor ambient lighting conditions such as near windows and under bright fluorescent lighting. It features high-quality OCLI HEA® glass, it integrates

perfectly with our cabinet design, and its anti-static coating prevents dust attraction.

➡ So pull the plug on your old monitor and upgrade to an NEC MultiSync FG. Once you look into our windows, you'll want to toss your old monitor out the window. For more information call:

1-800-NEC-INFO. (In Canada: 1-800-343-4418.)

For promotional details via fax call: NEC

FastFacts™ 1-800-366-0476. Request # 7777.

And get a free window shade.



*15" and 17" CRTs yield 13.8" and 15.6" active display areas.

Because  is the way you want to go.

NEC

Circle 521 on Inquiry Card.

Adjustable Notebook Viewing

With a tilt-and-swivel screen that seems to float above the keyboard, the Zeos Freestyle/SL Notebook provides a range of viewing angles. The 9½-inch-diagonal digitally controlled monochrome VGA LCD has a resolution of 640 by 480 pixels. The 386SL system can support a simultaneous display on an external color VGA monitor.

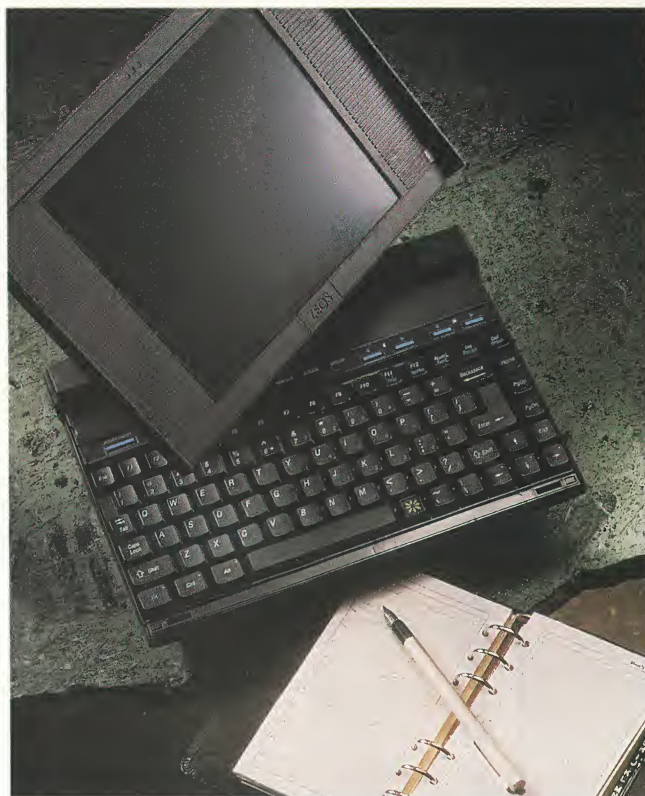
The 5½-pound notebook comes with 2 MB of RAM (expandable to 20 MB), a 1.44-MB floppy drive, and a 64-KB internal processor cache. Its power management system lets you extend the battery's normal 3 to 4 hours of operating time by several hours.

Other features are a built-in pointing key with left- and right-handed three-button mouse controls, flash ROM, and support for BIOS and video shadowing.

Price: Starts at \$1895.

Contact: Zeos International, Ltd., 530 Fifth Ave. NW, St. Paul, MN 55112, (800) 423-5891 or (612) 633-4591; fax (612) 633-1325.

Circle 1272 on Inquiry Card.



The Freestyle/SL Notebook's screen is held in place by a pivoting mechanism.

An Assistant for the Office

A complete integrated image- and document-preparation system, the mid-size tower Assistant is the basic model of Tangent's Image/Document Pro Series. The 25-MHz 486SX system features 8 MB of RAM, a 64-KB cache, a 240-MB IDE hard drive, and an internal 120-MB mini-cartridge tape backup unit.

Additional features are a Tangent graphics accelerator, a 15-inch flat square color monitor with 1024- by

768-pixel resolution, a Hewlett-Packard ScanJet IIC 24-bit color scanner, and a Logitech Mouseman. Software includes OmniPage Direct, Adobe Type Manager and Type Align, ImagePals Enhancer/Album/Capture, DOS 5.0, and Windows 3.1. The system comes with page-layout, word processing, and precision artwork software. **Price:** \$7995.

Contact: Tangent Computer, Inc., 197 Airport Blvd., Burlingame, CA 94010, (800) 466-3300 or (415) 342-9388; fax (415) 342-9380.

Circle 1271 on Inquiry Card.

66 MHz on a 486

The ITS 486DX-2 uses Intel's 486 processor chip running at 66 MHz and has a 256-KB write-back cache. The system includes 4 MB of RAM (expandable to 32

MB), an AMI BIOS, 1.2- and 1.44-MB floppy drives, and a 105-MB IDE hard drive with a 2-MB caching controller (expandable to 16 MB).

Interfaces on the ITS 486DX-2 include two serial ports, one parallel port, and a mouse port. The system has nine expansion slots. Graphics features include Super VGA capability and an S3 graphics accelerator with a maximum resolution of 1280 by 1024 pixels and 32,768 colors, plus a 14-inch Super VGA color monitor. The system comes with DOS 5.0 (or, optionally, OS/2) and Windows 3.1.

Price: About \$3798 (£1999).

Contact: Mainstream Computers Ltd., Chipping Manor, Wotton-under-Edge, Gloucestershire GL12 7AD, U.K., 44-453-844742; fax 44-453-844743.

Circle 1273 on Inquiry Card.

Choose Your Configuration

The Aurum GoldnoteS25 486SX notebook's removable hard drive configuration provides customizable storage capacity of 80 or 130 MB. Each 6-ounce drive has a seek time of 14.52 ms. Standard features are 4 MB of RAM (expandable to 16 MB), an 80-MB hard drive, a 1.44-MB floppy drive, two serial ports, a parallel port, and an IBM-compatible Award BIOS with advanced power management support. The nonglare backlit VGA LCD has a resolution of 640 by 480 pixels. DOS 5.0, Windows 3.1, and a carrying case are standard.

Price: \$1999; 80-MB hard drive, \$399; 130-MB hard drive, \$499.

Contact: Aurum Computer Corp., 5 Pond Park Rd., Hingham, MA 02043, (617) 749-5092; fax (617) 749-5188.

Circle 1274 on Inquiry Card.



Tangent's Assistant.

A Solar Panel for PowerBooks

A lightweight panel incorporating impact-resistant solar cells, SolarPower gives PowerBook users an alternative to reliance on the notebook's batteries. The panel attaches to the top of the PowerBook screen via a removable hinge, letting you swing the panel into position when you want to use it. Graphical software aids guide you to the correct positioning for maximum solar power. Optional cabling lets you also operate the unit at a distance from the PowerBook.

Price: \$189.

Contact: Microtech International, Inc., 158 Commerce St., East Haven, CT 06512, (800) 626-4276 or (203) 468-6223; fax (203) 467-1856.

Circle 1276 on Inquiry Card.



SolarPower lets you rely on the sun to extend battery life or recharge batteries in your PowerBook.

seven devices to a SCSI adapter. You set SCSI ID and termination via external switches. The DM-5024 also has an auto-switching power supply. Both units feature a volume control and a stereo headphone minijack.

Price: DM-3024, \$499; DM-5024, \$599.

Contact: Texel America, Inc., 1080C East Duane Ave., Sunnyvale, CA 94086, (800) 886-3935 or (408) 736-1374; fax (408) 736-1378.

Circle 1277 on Inquiry Card.

Reading Tool for the Blind

A stand-alone reading machine for the blind, the An Open Book Deluxe Edition is based on a 33-MHz 386 platform with 4 MB of RAM and an 80-MB hard drive. The unit comes with a DECTalk PC synthesizer to provide voice output and includes a keyboard and monitor. Also available is a Standard Edition, as well as An Open Book software for installation in existing computer systems.

Price: Deluxe Edition,

\$5995; Standard Edition, \$4995; software, \$995.

Contact: Arkenstone, Inc., 1185 Bordeaux Dr., Suite D, Sunnyvale, CA 94089, (800) 444-4443; fax (408) 745-6739.

Circle 1279 on Inquiry Card.

Portable Printer

A replaceable lead-acid battery pack provides the power for the SP-401B handheld printer. Able to print up to 7000 lines of text between battery charges, the printer features 40-column thermal printer technology, a 7-KB data buffer, and bidirectional RS-232 and RS-485 interfaces. The under-5-pound unit stamps each printout with the date and time and has an enclosed paper supply.

Price: \$496.

Contact: Syntest Corp., 40 Locke Dr., Marlborough, MA 01752, (508) 481-7827; fax (508) 481-5769.

Circle 1280 on Inquiry Card.

Handwritten Input

With the SummaScribe desktop graphics tablet and Microsoft Windows for Pen Computing, you can enter data and edit documents in handwritten form. The tablet, which has an active area of 6 by 9 inches with a two-button penlike stylus, works with desktop, laptop, and notebook PCs. It has drivers for AutoCAD, Windows, and Windows for Pen Computing.

Price: About \$568 (£299).

Contact: Summagraphics, Ltd., 140 Cromwell Rd., London SW7 4HA, U.K., 44-71-244-7733; fax 44-71-244-8584.

Circle 1281 on Inquiry Card.

Keyboard Intelligence

The MaxiPro II fully programmable keyboard for PCs and IBM PS/2s automatically senses the system it is connected to. Compatible with any software, the keyboard has its own nonvolatile internal memory. You can remap each of the 124 keys and program keys for special functions (e.g., diagonal cursor movement). The Macro Keys feature lets you program any key as a macro for complicated command lines, multilayered menus, or lengthy, often-used text; on-board memory holds up to 1800 characters.

Price: \$125.

Contact: Maxi Switch, Inc., 2901 East Elvira Rd., Tucson, AZ 85706, (602) 294-5450; fax (602) 294-6890.

Circle 1278 on Inquiry Card.



Display Color from Your PowerBook

A 16-bit graphics card for the PowerBook 140 and 170, the ColorBook 16 provides over 32,000 colors on projection devices and on displays as large as 16 inches. The board delivers 8-bit color on 19- and 21-inch displays.

The ColorBook 16's pass-through memory port accepts an Apple 2-MB memory upgrade. PSRAM (pseudostatic RAM) on the board is available in 2-, 4-, and 6-MB configurations. The QuickTime-compatible board fits in the PowerBook's expansion slot.

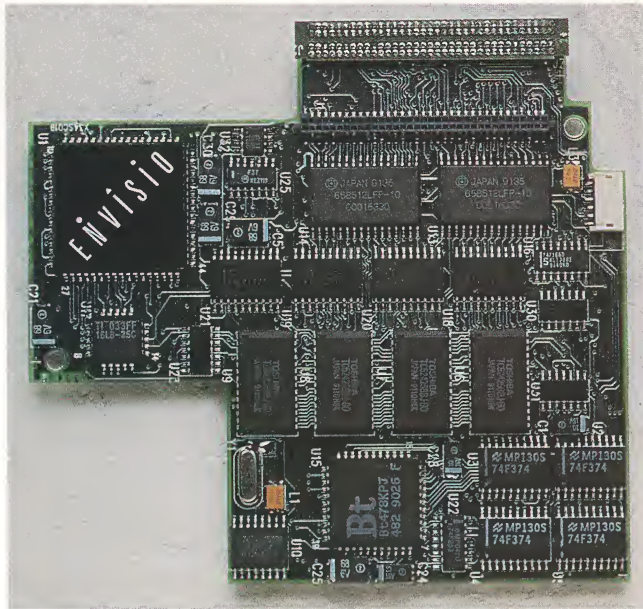
Price: Starts at \$1295.

Contact: Envisio, Inc., 510 First Ave. N, Suite 303, Minneapolis, MN 55403, (612) 339-1008; fax (612) 339-1369.

Circle 1282 on Inquiry Card.

Miniature Controller

The Little PLC, a low-cost, compact, C-programmable logic controller, features eight optically isolated inputs, eight relay driver outputs, a built-in switching power supply, and RS-485 serial communications. You program the 4- by 3-inch PC-compatible board using Z-World's Dynamic C software, which can handle 20,000 C statements. As the programs are compiled, they download to the Little PLC



The ColorBook 16 operates in QuickTime's native 16-bit depth to optimize the software's performance.

via the serial port.

Price: \$195.

Contact: Z-World Engineering, 1724 Picasso Ave., Davis, CA 95616, (916) 757-3737; fax (916) 753-5141.

Circle 1284 on Inquiry Card.

A Planet Connection

With the Planet ISDN card, you can connect your Mac to British Telecom's ISDN 2 network. The card supports both of the digital network's channels, providing simultaneous high-speed data and voice communications.

The Planet ISDN comes with Telephone Manager

software and an Apple standard Communications Toolbox driver, which allows up to eight applications to share one Planet ISDN card. Using the subaddressing features of ISDN 2, the card automatically routes incoming calls to the correct application.

Price: About \$2280 (£1200).

Contact: Mac Connect, 25 Low Friar St., Newcastle Upon Tyne NE1 5UE, U.K., 44-91-230-5596; fax 44-91-261-5746.

Circle 1283 on Inquiry Card.

Remote Graphics Display

The Video Line Driver add-in board lets you display your graphics on a monitor more than 900 feet from your computer through standard 75-ohm coaxial cable. The board amplifies the VGA signal and prevents it from breaking up prior to reaching its destination. The Video Line Driver is compatible with VGA and Super VGA adapters and Windows accelerators.

Price: \$369.

Contact: STB Systems, Inc., 1651 North Glenville, Suite 210, Richardson, TX 75081, (214) 234-8750.

Circle 1285 on Inquiry Card.

True-Color Controllers

The D24 BitBlaster uses a Cirrus Logic CL-GD5422 controller with 1 MB of RAM to provide 24-bit true color. Display drivers on the board include those for Windows 3.1 and AutoCAD. A companion board, the V24 BitBlaster, uses S3's 86C924 graphics controller with 1 MB of VRAM and an AT&T 24-bit RAMDAC.

Price: D24 BitBlaster, \$99; V24 BitBlaster, \$199.

Contact: Edge Technology, Inc., 915 East Karcher Rd., Nampa, ID 83687, (208) 465-3434; fax (208) 465-3424.

Circle 1286 on Inquiry Card.

Single-Slot Expansion

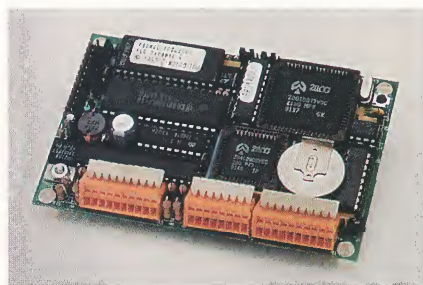
Windows-, multimedia-, and network-compatible, the One Slot board provides four serial and three parallel ports. The board fits in a single ISA or EISA expansion slot and supports laser and dot-matrix printers, mice, plotters, modems, and bar code readers.

The EIA-232 serial ports include full-duplex communications capability. You can disable the serial ports as well as the bidirectional Centronics ports via switch selection.

Price: \$349.

Contact: Star Gate Technologies, Inc., 29300 Aurora Rd., Solon, OH 44139, (800) 782-7428 or (216) 349-1860; fax (216) 349-2056.

Circle 1287 on Inquiry Card.



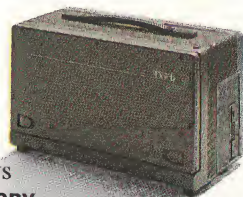
The Little PLC miniature controller has an expansion bus for peripheral devices.

Try stuffing these into a laptop.



Laptops have their place, but for mission-critical applications requiring serious expansion, workstation power, CRT-quality screens or toolbox ruggedness, get a P.A.C.™ (Portable Add-In Computer).

■ **MASSIVE EXPANSION.** Nobody gives you more expansion possibilities than Dolch. In an 18 pound package a Dolch P.A.C. has room for up to five full-size EISA/ISA add-in cards. You can add up to 32 MB RAM, 1 GB HDD, and any combination of drives, CD-ROM, removable HD, streaming tape, and more. ■ **EXTREME POWER.** Dolch P.A.C. systems have been rated "the fastest portables on the market" since 1987, and have won more Editor's Choice awards than any other product in its category. *Computer Reseller News* calls the 486-50E "a dream machine . . . one of the most powerful PCs of any kind." P.A.C. systems are based on 386SX and DX, and 486 CPUs up to 50MHz, delivering as much as 22 MIPs. ■ **DAZZLING DISPLAYS.** "Breathtaking . . . Dolch's heart-stopping TFT Color Display produces vibrant colors and sharp images virtually on par with those seen on desktop VGA monitors," reports *PC Computing*. ■ **MIL RUGGEDNESS.** Every P.A.C. is as tough as it is powerful. Certified under MIL Std. 810C Dolch provides true mission critical reliability. ". . . it simply outclasses its competitors and it is sturdy and solid . . ." says *PC Magazine*. ■ **GET THE FULL STORY.** Call 1.800.995.7581. In Canada 1.800.561.4527.



POWER PORTABLE ADD-VANTAGE

DOLCH COMPUTER SYSTEMS • 372 TURQUOISE STREET • MILPITAS • CALIFORNIA 95035 • USA



1989



1989



1990



1990



1991



1991



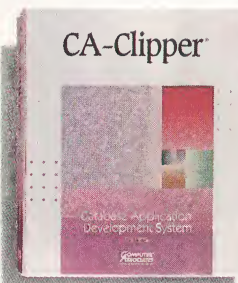
1992

For Xbase Roads Lead

It's been a very difficult and confusing couple of years for Xbase developers. Filled with uncertainty and doubt about the future. At times, some questioned whether Xbase even had a future.

But those days are over.

With the resources, experience and support of the world's leading database company behind it, and with the combined technological wealth of CA-Clipper®, CA-dBFast™ and Computer Associates, the future of Xbase has never looked brighter.



Millions Of Clipper, dBASE, Fox And CA-dBFast Developers Head For The Next Generation Xbase System.

To build the Xbase system of the future, we've added CA's visual tool and client-server technology to Nantucket's next generation Xbase project.

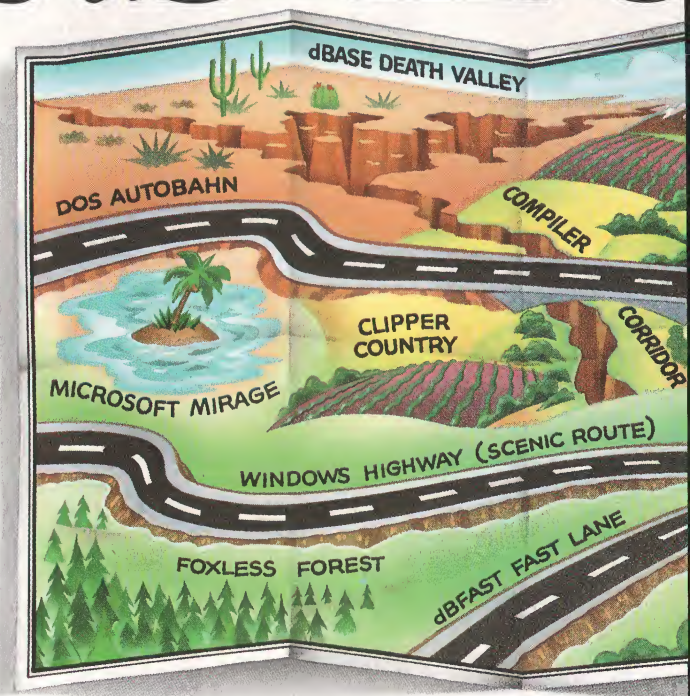


This new system will provide a fully object-oriented Xbase language, native code compiler, an IDE (Integrated Development Environment) and both DBF-style and client-server database support.

It will support Windows, Windows NT, OS/2 and UNIX. The complete product will be demonstrated at Fall Comdex and available for beta testing in the fourth quarter of 1992.

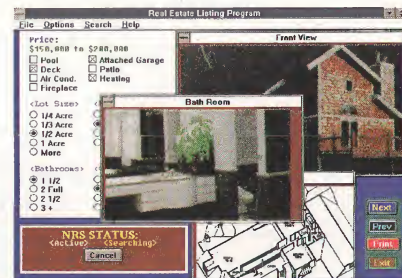
Two Easy Ways To Get There: Go GUI Today With CA-dBFast Or Go The DOS Route With OOP Via Clipper. Your Choice.

There are two migration paths to this ultimate Xbase system: The OOP (Object-Oriented Programming) path of



CA-Clipper and the GUI (Graphical User Interface) path of CA-dBFast with Windows support.

Both paths will provide immediate benefits and will protect and leverage the substantial investments you've made in Xbase.



Attention All dBASE IV Developers: Your CA-Clipper/Compiler Kit Has Arrived.

After four years, the compiler kit you've been waiting

se All ad To CA.



Secure Your Future When You Team Up With The World's Leading Database Software Company.

Much more than a PC software company, CA is the world's leading database software company. CA software is used in over 70 countries around the world by more than 10 million users including over 90% of the Fortune 500.

From mainframe to midrange to microcomputers, CA database software runs on more platforms, more operating systems, and handles more mission-critical applications than any other software in the world.

CA90s

CA's Computing
Architecture
For The 90s.

For Information On CA-Clipper, CA-dBFast And A Statement Of Direction: Call 1-800 CALL CAI.

To get the complete story on The Future of Xbase, call for this special 30-page statement of direction.

It contains an Executive Summary as well as an in-depth discussion of Xbase in the 90s, CA's

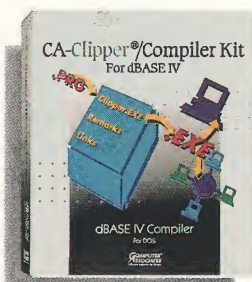
Open and Client-Server Architectures, Integrated Development Environment, Xbase migration plans and end-user tools.

Call for your copy today.

And find out why the future of Xbase will lead you right to CA.



The
Future
of
Xbase
COMPUTER ASSOCIATES



for has arrived. Introducing new CA-Clipper/Compiler Kit For dBASE IV. The easiest, quickest way in the world to compile a dBASE IV application.

All it takes is three easy steps. And in just minutes, you can turn most dBASE IV programs into faster running, higher performance programs.

The new CA-Clipper/Compiler Kit For dBASE IV provides compatibility and database interoperability with most dBASE IV applications. The Kit is implemented using the open architecture of CA-Clipper, including the preprocessor, the Extend System and the RDDs.

Create a New Ion Field

Now you can neutralize all positive ion radiation from your computer screen by reversing the positive ion field to a negative field of up to 100 square feet. The mouse-size Perfect-Aire 100 attaches to the top of your monitor with Velcro and plugs into a standard 110-V outlet. By eliminating electrostatic radiation, the unit not only cleans up the air around you and your computer, but also protects your monitor from static electricity discharge.

Price: \$139.95.

Contact: Planmar Marketing, Inc., P.O. Box 13826, Research Triangle Park, NC 27709, (919) 383-3818; fax (919) 383-2871.

Circle 1288 on Inquiry Card.



The Perfect-Aire 100 neutralizes positive radiation from the screen, top, and sides of your monitor.

Phone from Your Keyboard

Integrated Technology's PC-compatible 101-key CompuPhone keyboard is integrated with a single-line phone circuit and equipped with an interface for a headset, eliminating the need for a separate phone when you're telecommunicating. You use the numeric keypad for dialing; auto-dialing software is included.

Price: \$299.

Contact: Integrated Technology, Inc., 76 South Orange Ave., South Orange, NJ 07079, (201) 907-0200; fax (201) 762-7234.

Circle 1290 on Inquiry Card.

Precise Power

The Onguard Universal Precision Regulators from Clary use a modular approach to power protection. Providing precision line regulation, the units protect your workstation via a ride-through capability based on a proprietary capacitor design. This capability protects your com-

puter against momentary disturbances such as sags, spikes, surges, noise, and voltage/frequency deviations. You can expand protection with options such as a battery backup and a dedicated-input DC-to-AC inverter.

Price: Starts at \$890.

Contact: Clary Corp., 1960 South Walker Ave., Monrovia, CA 91016, (818) 359-4486; fax (818) 305-0254.

Circle 1291 on Inquiry Card.

Trap Your Mouse

The Mousetrap enables you to use your mouse from your lap rather than just from your desktop. A fully adjustable keyboard-mounted side tray for your mouse, trackball, or other input device, the Mousetrap quickly clamps onto most keyboards for right- or left-handed use.

Price: \$21.95.

Contact: Armchair General, P.O. Box 2211, Twin Falls, ID 83303, (208) 733-7538.

Circle 1292 on Inquiry Card.

Trackballs for Everyone

The Spaceball 2003 provides an intuitive way to rotate and move 3-D objects on IBM, Sun, Silicon Graphics, and DEC workstations. You can manipulate screen objects about the x, y, and z axes simultaneously with just a touch. Increasing pressure on the ball increases the speed of an object's rotation.

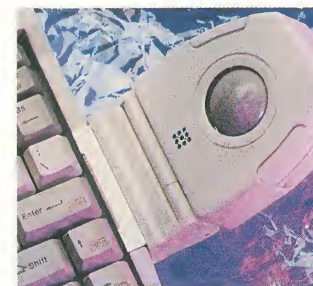


Price: \$1595.

Contact: Digitizer Products Group, Calcomp, Inc., 14555 North 82nd St., Scottsdale, AZ 85260, (602) 948-6540.

Circle 1293 on Inquiry Card.

Featuring a swiveling two-button control for right- and left-handed use, the SuperTrak is Microsoft compatible. The unit fits in your hand or attaches to the side of your notebook or laptop. If you bump the trackball, its breakaway design prevents damage to it or your computer. Models are available for PCs and PS/2s.



Price: \$99.

Contact: Z-Nix Co., Inc., 211 Erie St., Pomona, CA 91768, (714) 629-8050; fax (714) 629-4792.

Circle 1294 on Inquiry Card.

PC Remote Control

A 26-button hand-held infrared transmitter, the Mind Path SR50 attaches to your computer's serial port. The transmitter lets you control any DOS or Windows program from up to 50 feet away.

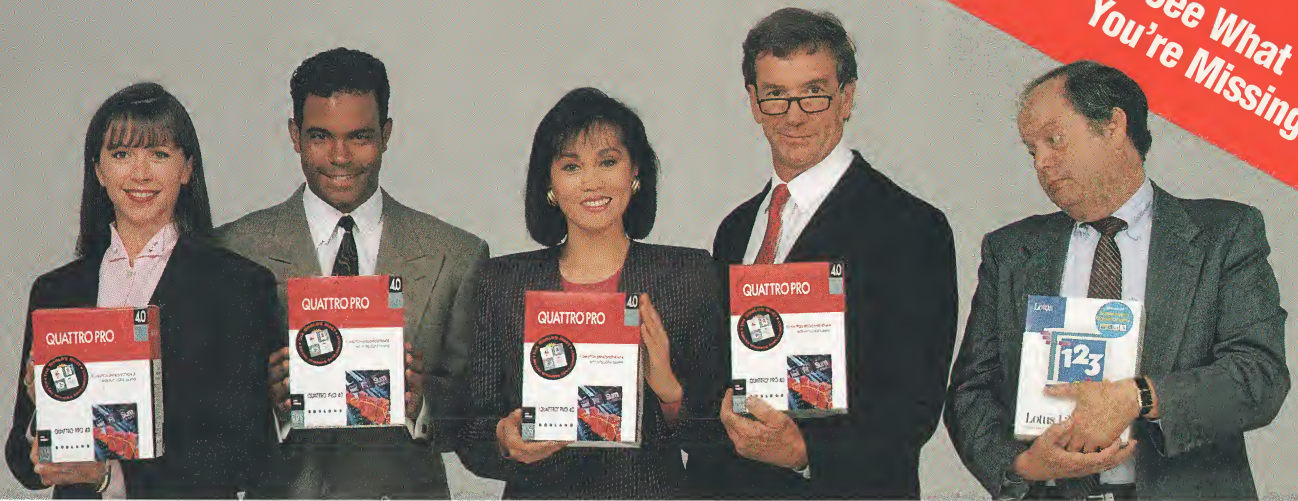
Looking much like a remote control for your TV, the Mind Path SR50 can be re-configured for any application via a menu-driven program. Each button on the unit works as a single keyboard key or a sequence of keys, and you can encode security keys into the buttons. The unit has full CRC-16 error checking built in. The fiberglass-reinforced plastic case is water and dust resistant.

Price: \$495.

Contact: Mind Path Technologies, 12700 Park Central Dr., Suite 1807, Dallas, TX 75251, (214) 233-9296; fax (214) 233-9308.

Circle 1289 on Inquiry Card.

See What
You're Missing



4 out of 5 Lotus 1-2-3 users prefer Quattro Pro for DOS

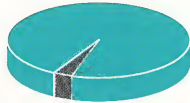
An independent study proves it!

When Lotus 1-2-3 users compared Quattro® Pro 4.0 and 1-2-3 side-by-side, they made a startling discovery. Four out of five found they preferred Quattro Pro from Borland over Lotus 1-2-3. They said Quattro Pro is easier to use than 1-2-3. They said it is richer in features and functionality than 1-2-3. In fact, 94 percent said they would be more productive with Quattro Pro 4.0 than 1-2-3!

The tests were conducted by Usability Sciences Corporation, a highly regarded independent testing lab used by major software publishers, including Lotus. The 1-2-3 users evaluated both products in 20 major categories, including analytical power, speed, graphics, ease of learning, printing, macros, and more. In *every* category, 1-2-3 users preferred

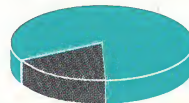
Which product would make
you more productive?

Quattro Pro (94%)



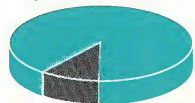
Which product is
easier to use?

Quattro Pro (78%)



Which product is richer
in feature and function?

Quattro Pro (83%)



Source: Usability Sciences Corporation, May-July 1992

Quattro Pro. With Quattro Pro, you simply get your work done faster.

Switching is easy

Stepping up to Quattro Pro is fast, simple, and painless. Your 1-2-3 files and publishing styles move effortlessly into Quattro Pro. You can even run your 1-2-3 macros.

The Usability Sciences study provides overwhelming proof that when 1-2-3 users just like you try Quattro Pro, they want to switch. Try Quattro Pro today and make your own comparison. If you don't prefer it, return it. We'll give you your money back.



See your dealer today
or call

1-800-331-0877,
ext. 5751

In Canada, call 1-800-461-3327



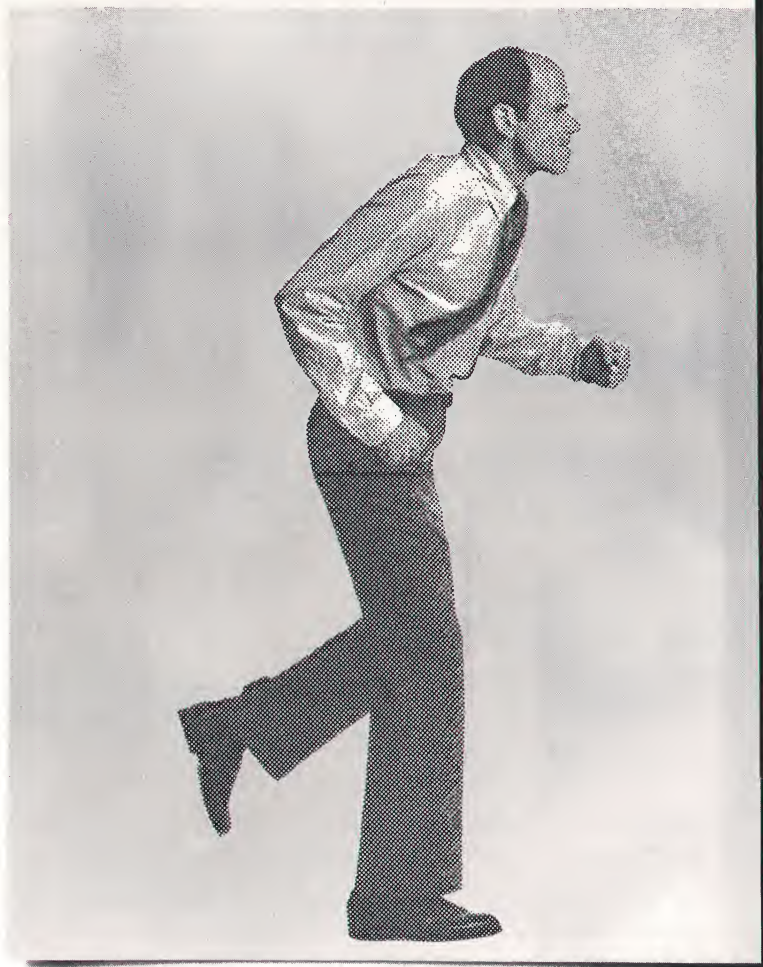
B O R L A N D
Software Craftsmanship

Copyright © 1992 Borland International, Inc. All rights reserved. Quattro is a registered trademark of Borland International, Inc. BI 4305

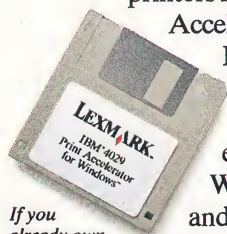
Circle 94 on Inquiry Card (RESELLERS: 95).

IBM LaserPrinters: The Windows. And

Most laser printers slow to a walk under Windows.



Announcing a Windows™ driver designed to leave other printers in the dust: the new IBM® 4029 Print Accelerator for Windows.



If you already own a LaserPrinter 5E, 6, 6P, 10, 10P, or 10L, call 1 800 358-5835 for your **free** driver upgrade.*

It's now standard equipment on IBM LaserPrinter Models 5E, 6, 6P, 10, 10P, and 10L, at no extra cost. And it delivers supercharged printing speeds with Windows—for more of the productivity and convenience that Windows is all about.

Now complex graphics and multiple fonts print with surprising speed. You can use both Type 1 and TrueType™ fonts. And you get the crisp, 300 dpi output and superb

Application	HP® LaserJet® III with standard Windows driver	IBM LaserPrinter 10 with Print Accelerator for Windows	Speed Increase
Harvard Graphics®	1566 seconds	633 seconds	147%
Aldus®PageMaker®	85 seconds	52 seconds	62%
CorelDRAW™	126 seconds	96 seconds	31%

Independent NSTL testing, using complex text-and-graphics documents.

*Free upgrade available through 10/18/92. Print Accelerator requires a PC with 386 SX processor or higher and 4MB of RAM. IBM is a registered trademark of International Business Machines Corporation in the U.S. and/or other countries and is used under license. HP and LaserJet are registered trademarks of Hewlett-Packard Company. Harvard Graphics is a registered trademark of Harvard Graphics Corporation.

I B M L A S E R P R I N T

difference between power Windows.



With the new Print Accelerator for Windows, IBM LaserPrinters keep you comfortably ahead.

paper handling IBM LaserPrinters are famous for.

IBM LaserPrinters come to you from Lexmark International, an independent worldwide company, formerly a division of IBM, that develops, manufactures, and markets IBM personal printers, IBM typewriters, related supplies, and keyboards.



Up to 150% faster Windows printing, on the LaserPrinter 5E, 6, 6P, 10, 10P, and 10L.

For your nearest dealer, call 1 800 358-5835 (in Canada, 1 800 663-7662).

And see something truly unique: a laser printer that can fly through Windows. And look great doing it.

IBM Personal Printers by

LEXMARK™

Make Your Mark

Circle 136 on Inquiry Card.

Software Publishing Corporation. Aldus and PageMaker are registered trademarks of Aldus Corporation. Lexmark is a trademark of Lexmark International, Inc. TrueType is a trademark of Apple Computer, Inc., registered in the U.S. and other countries. Windows is a trademark of Microsoft Corporation. CorelDRAW is a trademark of Corel Systems. © 1992 Lexmark International, Inc.

ERS. PAGES AHEAD.

Video Stars on the LAN

Based on a real-time Unix operating system, StarWorks software turns your 486 EISA computer into a video application server that can simultaneously support as many as 20 PCs running DOS or Windows and Macs. The software's Media Transport Protocol enables each user to access the same video file at different starting times.

Initially, StarWorks supports 10Base-2 and 10Base-T Ethernet and provides video networking services for up to a total network bandwidth of 25 Mbps. The software is compatible with digital video systems such as DVI, QuickTime, and AVI. It also supports MPEG and JPEG systems.

Price: Starts at \$9950.

Contact: Starlight Networks, Inc., 444 Castro St., Suite 301, Mountain View, CA 94041, (415) 967-2774; fax (415) 967-0686.

Circle 1295 on Inquiry Card.



StarWorks software turns a 486 EISA server into a video application server.

LC. Like the MacNet-SE-470, the MacNet-LC-480 is IEEE 802.3 compliant and provides a 10-Mbps transfer rate in its CSMA/CD packet passing.

Price: \$299 each.

Contact: MacNet, 2199 Zanker Rd., San Jose, CA 95131, (408) 954-8888; fax (408) 954-8866.

Circle 1298 on Inquiry Card.

Put Your Mac on the Network

Built for Mac IIx and SE/30 computers, the MacNet-SE-470 is a combination IIx and SE-30 Ethernet card. With RJ-45, AUI, and BNC connectors, the card is IEEE 802.3 compliant and uses CSMA/CD packet passing with a transfer rate of 10 Mbps.

A second card, the MacNet-LC-480, is a 10Base-2/T card that works with the Mac

Automatic Backup and Retrieval

You can automatically back up and retrieve up to 50 GB of data on NetWare networks with the Fast 5000 AutoLoader package from Palindrome. The hardware and software system combines robotic automation of tape loading and rotation with full management of data mi-

grated from network to tape.

The Fast 5000 AutoLoader hardware provides unattended backups, automated server and volume restoration, and an automated disaster recovery system. The software, Palindrome's The Network Archivist, can track files and file histories through its relational databases, facilitating totally unattended tape rotations for backups. TNA knows where every version of every file is located on tape. You can also send backup and restore commands by E-mail.

Price: Fast 5000 AutoLoader, about \$21,850 (£11,500); TNA, starts at about \$1510 (£795).

Contact: Palindrome (U.K.), Ltd., 2 Burlington Court, Burlington Rd., Slough, Berkshire SL1 2JS, U.K., 44-753-810751; fax 44-753-810624.

Circle 1296 on Inquiry Card.

Network Utility

SoftNet Utilities lets Hewlett-Packard 9000 Series 7xx, IBM RISC System/6000, and SPARC-based workstations and

servers act as nondedicated NetWare-compatible servers. The package includes terminal-emulation software that allows PC workstations to use the IPX protocol to remotely log onto Unix hosts. **Price:** Starts at \$1295 for a 16-user license.

Contact: Puzzle Systems Corp., 16360 Monterey Rd., Suite 250, Morgan Hill, CA 95037, (408) 779-9909.

Circle 1297 on Inquiry Card.

Remote Ethernet Link for Apple

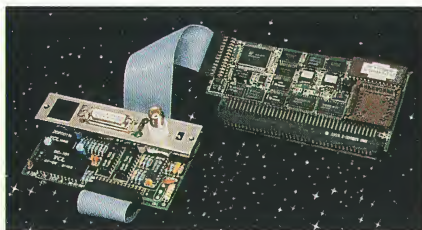
GatorLink, a dedicated ARA (AppleTalk Remote Access) server that fully supports the ARAP (AppleTalk Remote Access Protocol), permits up to three remote PowerBooks or Macs to simultaneously dial into an Ethernet network. The units can directly access file servers, E-mail, and printers as if they were local nodes on the network.

Other features include enhanced access control in the form of zone lists that let network administrators select which AppleTalk zones will be visible to dial-in users, emergency quick-disconnect capability on each port, and scalable configuration and administration. A Motorola 68302 CPU handles all serial I/O duties, leaving the MC68000 core free to process basic ARA services. GatorLink also supports token-based, randomly changing user-authentication codes, as well as static user names and passwords.

Price: \$1899.

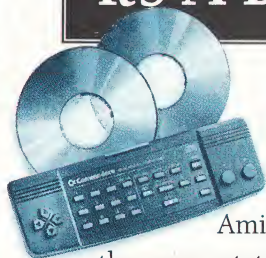
Contact: Cayman Systems, Inc., 26 Landsdowne St., Cambridge, MA 02139, (617) 494-1999.

Circle 1299 on Inquiry Card.



The MacNet-SE-470.

The Amiga® Isn't Just A Better Way To Present. It's A Better Way To Sell.



What's the difference between a presentation created with the Amiga® and every other presentation?

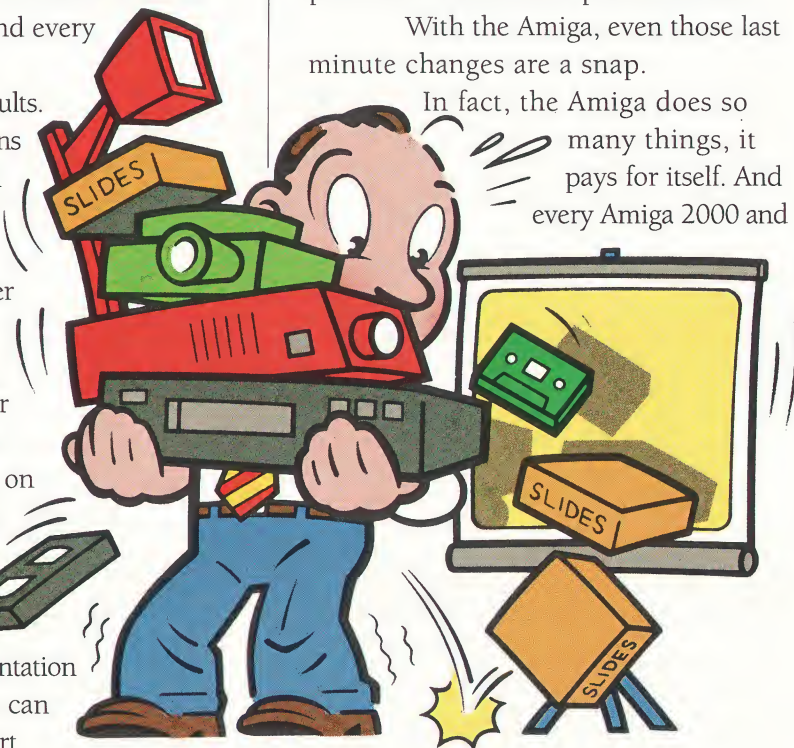
In a word, results. Because the Amiga turns a ho-hum presentation into a persuasive multimedia show.

You can deliver your presentation on a TV monitor, output onto slides or video, or press a CD-ROM and present your message on CDTV® (Commodore Dynamic Television), the lowest cost high performance multimedia presentation system available. You can also import and export files to both PC-compatible computers* and Macintosh™,* or easily connect to an existing Novell™ network.*

Presentation professionals can also take advantage of special software programs.

SCALA® 2.0 features a simple point-and-click menu for integrating text, animation, drawings, slides, photos and music so you can create striking, attention-getting screen presentations.

Presentation Master™ offers a paint program, business graphics module, and



The Amiga does so many things, it virtually pays for itself.

color postscript output all in one package, so you can design, display and output powerful multimedia presentations.

With the Amiga, even those last minute changes are a snap.

In fact, the Amiga does so many things, it pays for itself. And every Amiga 2000 and

3000 series computer comes with Commodore Express Gold service options** and convenient leasing terms.

For more information, call 1-800-66-AMIGA. (In Canada, call 1-800-661-AMIGA.)

The Amiga. The presentation system more people are sold on.



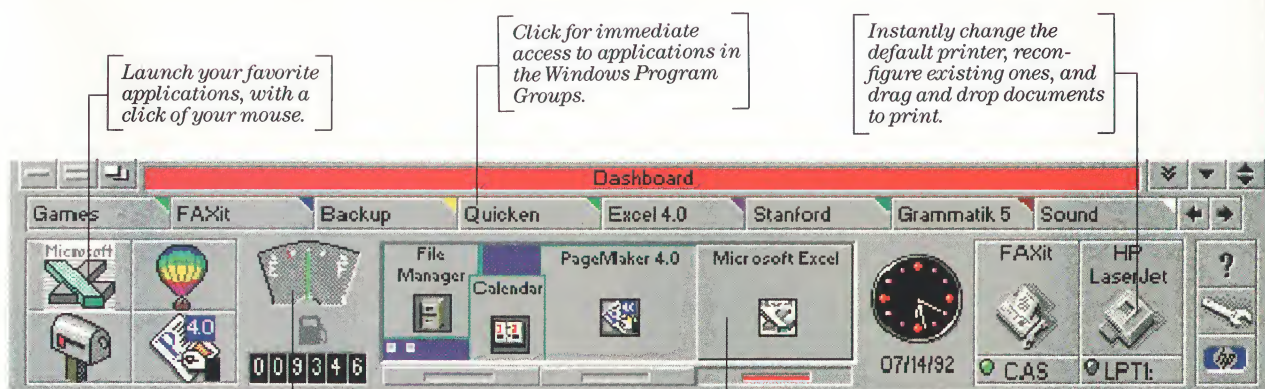
Commodore®
AMIGA®

© 1992 Commodore Business Machines Inc. Commodore and the Commodore logo are registered trademarks of Commodore Electronics Ltd. Amiga is a registered trademark of Commodore-Amiga, Inc. Products available on GSA schedule GS-00K-91-AGS-5069. *With available hardware/software. **Available only on systems purchased in the U.S. through an authorized Commodore-Amiga dealer. Customer activation required. Nominal fee for some options. Macintosh is a registered trademark of Apple Computer Inc. Novell is a registered trademark of Novell Inc. SCALA is a registered trademark of SCALA Inc. Presentation Master is a registered trademark of OXXI, Inc.

Circle 102 on Inquiry Card.



INTRO A LITTLE SOM WINDOWS SI



Actual Size

Monitor and control memory and system resources with the Resource Gauge.

Instantly switch between complete screen setups in up to 9 full-screen views in just one step.

ard

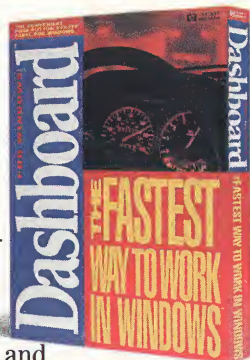


INTRODUCING SOMETHING FOR SPEED FREAKS

Mention the word "fast," and Windows users get a wild look in their eyes. Why? Because they have a need. A need for speed. Well, here's a little something that satisfies those cravings: Introducing Dashboard™. The fastest way to work in Windows.™

Dashboard is the convenient push-button utility panel that makes quick work of complicated operations in Microsoft Windows®. Zip into your favorite applica-

tions with a click. Switch between different full-screen views of applications in one step. Instantly change the printer default, or drag and drop documents to print... never has so much speed and convenience been packed into so little screen and disk space. Everything, even a clock with alarms, and a "fuel" gauge to monitor your memory usage, is



instantly accessible. Whenever you feel the urge.

So the next time you get that uncontrollable craving, you'll know what to do. Grab hold of the world's

fastest push-button utility panel, Dashboard For Windows. And get all the speed you need.

See your dealer or call
1-800-554-1305 Ext. 801B.

FOR WINDOWS
Dashboard
The Fastest Way To Work In Windows™



HEWLETT
PACKARD

© 1992 Hewlett-Packard. Fax inquiries 408-720-3560. Dashboard and The Fastest Way To Work In Windows are trademarks of Hewlett-Packard Company. Microsoft Windows is a registered trademark of Microsoft Corp.

Circle 134 on Inquiry Card

A Fax Modem to Travel With

The Traveler 9600-/4800-bps portable send/receive fax modem works in the background on your notebook computer, letting you continue to work in your application. With the Traveler, you can view, rotate, or print the faxes you want and delete the faxes you don't want without printing them.

The Traveler includes a 2400-bps data modem with V.42bis and MNP 5 data compression and V.42 and MNP 2 through 4 error correction. The unit operates via battery or AC power and is available in a standard DOS version, a Windows version, and as the MacTraveler for use with Macs.

Price: \$199.

Contact: Best Data Products, Inc., 9304 Deering Ave., Chatsworth, CA 91311, (818) 773-9600; fax (818) 773-9619.

Circle 1300 on Inquiry Card.

Two Mac FDDI Adapters

The F6069 Desktop Network Interface card from Cabletron Systems provides a direct connection of Mac II and Quadra computers to 100-Mbps FDDI (Fiber Distributed Data Interface) networks. The processing for on-board protocol and management is via a Motorola 68ec020 processor. The adapter uses Motorola's FDDI chip set as well as EEPROM chips. The company's LanView Diagnostic System provides link and activity information. The adapter supports FDDI Station Management 6.2 and is compatible with System 6.x and 7.x and Unix 3.x operating systems.

Price: \$2995.



The pocket-size Traveler fax modem has auto-answer and auto-dial, as well as time-scheduled transmission. The unit is also a 2400-/1200-/300-bps asynchronous data modem.

Contact: Cabletron Systems, Inc., 35 Industrial Way, Rochester, NH 03867, (603) 332-9400.

Circle 1301 on Inquiry Card.

Codenoll Technology's CodeNet-9550, -9553, and -9750 NuBus/FDDI adapters also let you directly attach Mac and Quadra systems to a 100-Mbps FDDI network, as well as to an SDDI (shielded-twisted-pair FDDI) network. The adapters all have an on-board Motorola 68020 processor and fit in any Mac or Quadra NuBus-90 slot. They automatically use the enhanced data transfer capabilities of the NuBus-90 system. On-board diagnostics run on initialization or on user demand, and an on-board LED verifies the operational status of the adapter or indicates diagnostic failure.

Price: CodeNet-9550 Single Attached Station adapter, \$3995; CodeNet-9553 Dual Attached Station adapter, \$4995; CodeNet-9750 SDDI NuBus adapter, \$3495.

Contact: Codenoll Technology Corp., 1086 North Broadway, Yonkers, NY 10701, (914) 965-6300; fax (914) 965-9811.

Circle 1302 on Inquiry Card.

A Windows Network Manager

An SNMP network manager for Windows, SNMPc 3.0 uses AI techniques to simplify manipulating MIB objects. You can perform any function with a single button click after you've selected a structured data object. You can also define custom menu options that execute any command sequence.

Additional features of SNMPc include multilevel graphical map representation, automatic node discovery and map creation, real-time statistics graphs or lists, and event action filters. SNMPc exports data to a printer or disk files or through DDE and supports Windows TCP/IP products.

Price: \$495.

Contact: Castle Rock Computing, Inc., 20863 Stevens Creek Blvd., Suite 530, Cupertino, CA 95014, (408) 366-6540; fax (408) 252-2379.

Circle 1303 on Inquiry Card.

Carry Your Network Adapter with You

A portable network adapter that attaches to your laptop's parallel port, the TPair-PNA/QL comes with all the hardware and software need-

ed to connect to a 10Base-T network. An integrated auxiliary parallel port on the adapter provides continued local printing capability.

With TPair-PNA/QL you can interact with different protocol environments as if they were attached to local drives. In Windows, you click on a button to simultaneously access data on different servers running such operating systems as LAN Manager, NetWare, Net-BIOS, and Vines. An SNMP agent provides support for MIB I, II, and 179.

Price: \$468.

Contact: Intellicom, Inc., 20415 Nordhoff St., Chatsworth, CA 91311, (818) 407-3900; fax (818) 882-2404.

Circle 1304 on Inquiry Card.

Fax Server Upgrade

The self-contained FaxPress 3.0 LAN fax server lets you do your faxing from your desktop while on the network. Fully integrated with NetWare, FaxPress gives you the choice of getting your faxes on a network printer, on a FaxPress-connected printer, or in your mailbox.

New capabilities in the software include auto-routing, support for Printer Control Language 5, and support for translation to languages other than English. A link to Novell Bindery lets you become a fax server user while on the LAN. Customized user preferences let you define a personal set of defaults. A dual-line version lets you send and receive faxes simultaneously.

Price: Single-line, \$3495; dual-line, \$4395.

Contact: Castelle, 3255-3 Scott Blvd., Santa Clara, CA 95054, (408) 496-0474; fax (408) 496-0502.

Circle 1345 on Inquiry Card.

WATCOM SQL

PC-based Client/Server SQL Tools

Four Good Reasons to get your copy right away:

1. True Client/Server for reliability and performance

Your databases are protected from corruption by features such as referential and entity integrity, as well as true transaction processing. Client/server architecture and our 32-bit database server software help deliver increased performance for applications running on your PC LANs.

2. Royalty-free run-time

For just \$99 you get royalty-free run-time support. It lets you distribute applications for standalone PCs and include our single-user run-time database server. It also lets you distribute your applications on an unlimited number of client machines in network environments.

3. Scalability

Whether you implement applications using the ACME front-end or write them in C or C++, they can be designed to run without change in environments ranging from standalone 640K single-user PCs to large networks running our

high-performance multi-user database server.

From entry level PCs... You can use DOS PCs with just 640K memory as database server machines for small networks. For single-user standalone environments, the SQL database server together with an application can run on DOS PCs equipped with a minimum of 640K memory.

...to high end servers. The WATCOM SQL database server automatically adapts to utilize the available memory on your system for increased performance. The 32-bit version unleashes the power of 386/486 PC's to efficiently serve many clients in large networks.

4. For a limited time it's yours for just \$395

WATCOM SQL Developer's Edition has a suggested retail price of \$795 but for a limited time you can get it at the introductory price of only \$395. Even better, as a registered user of the Developer's Edition you'll be able to get a copy of the 6-user Network Server Edition for only \$99 (Suggested retail price: \$795).

Developer's Edition

Complete Client/Server Development Tools Package Including Standalone Single-user SQL Database Engine

The Developer's Edition allows you to develop and deploy single-user standalone applications, and to develop applications for use with the WATCOM SQL Network Server Edition. You get the **ACME (Application Creation Made Easy)** front-end application development system. It combines visual forms design with simple event-driven programming to allow rapid prototyping and development of client applications without C programming. The Developer's Edition also includes IBM SAA standard embedded SQL support for C/C++ and application development with WATCOM, Microsoft and Borland compilers.

Package components include: Single-user standalone database server (both 16 and 32-bit versions) • Interactive SQL • ACME front-end application development system • Embedded SQL/C preprocessor • SQL libraries for use with WATCOM C, WATCOM C/386, Microsoft C/C++, and Borland C/C++.

System Requirements:

Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Special Introductory Offer: \$395 (Suggested retail price: \$795)

Special offers available to registered users: (details inside package)

- Royalty-free run-time support: \$99
- 6-user Network Server Edition: \$99 (Suggested retail price: \$795)

Network Server Edition

High-performance Multi-user SQL Database Server for PC LANs

The Network Server Edition provides client/server support for multiple concurrent users in a local area network environment. The WATCOM SQL database server supports ANSI standard SQL and provides advanced capabilities, including bi-directional scrollable updatable cursors, referential integrity, row-level locking and symmetric multiprocessing of requests. WATCOM SQL also gives you comprehensive security capabilities, data encryption and data compression. Compatible programming interfaces let you implement applications that run without change using either the standalone single-user database or the Network Server Edition.

Package components include: Multi-user network database server (both 16 and 32-bit versions) • Interactive SQL • Network requestor and request manager.

Client System Requirements:

Hardware: IBM PC compatibles, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Database Server System Requirements:

Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS

Network Requirements: NetBIOS or Novell Netware (IPX)

Suggested Retail Price: 6-user version: \$795
Unlimited version: \$1,595

WATCOM, 415 Phillip Street, Waterloo, Ontario, Canada N2L 3X2
Telephone: (519) 886-3700, Fax: (519) 747-4971

Prices do not include freight and taxes where applicable. Authorized dealers may sell for less. WATCOM SQL, the Lightning Device, and Application Creation Made Easy are trademarks of WATCOM International Corporation. Other trademarks are the properties of their respective owners. Copyright 1992 WATCOM International Corporation.

WATCOM

1-800-265-4555

The Leader in Development Tools

Circle 220 on Inquiry Card.



Brilliant minds no

Especially with the new 17" Brilliance 1710, high-resolution, low-emission MPR-II monitor. It gives the clearest, most relaxing view of your windows, DTP and graphics applications.

With resolutions up to 1280 x 1024 even the finest details are crystal clear. The Black Matrix tube with flat, square screen delivers high contrast and no distortion.

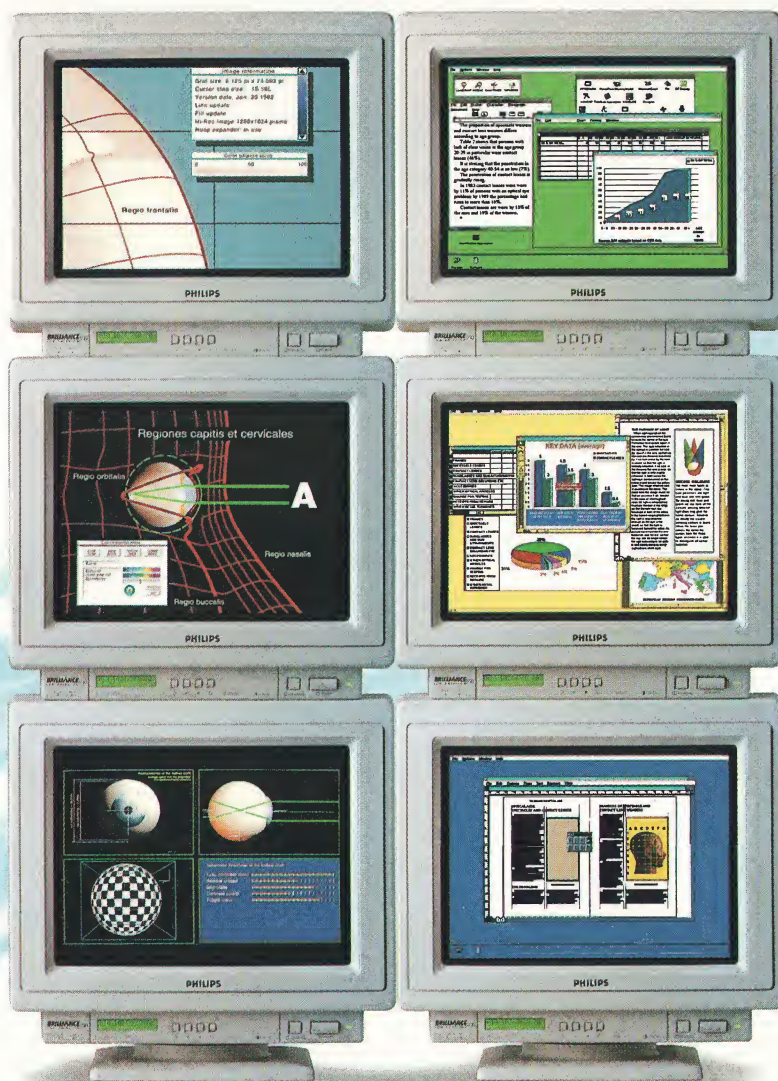
High refresh rates, for example 75 Hz in the 1024 x 768 mode,

ensure both high-resolution and flicker-free image stability.

Digital control makes it easy to switch between 26 preset user-programmable display modes, without having to set the adjustments. The front panel LCD display clearly shows status and settings.

With Autoscan for multi-compatibility, the Brilliance 1710 matches your PC, workstation or Macintosh perfectly and handles virtually all today's high-resolution video cards.





Brilliance is a registered trademark of Philips Electronics N.V. Windows is a trademark of Microsoft Corp. Macintosh is a registered trademark of Apple Computer Inc.

... see even better.

There is a complete range of Brilliance monitors, from Super VGA for everyday business use, to 21" with resolutions up to 600 x 1280 for demanding professional applications.

For brilliant support, and more information, contact:

Philips Monitors, SFF-7, PO Box 80002

5600 JB Eindhoven, The Netherlands, fax +31 40 733983

BRILLIANCE[®]
HIGH RESOLUTION MONITORS

PHILIPS

Circle 411 on Inquiry Card.

Design Large Industrial Projects

Interactive Software Engineering designed ISE Eiffel 3, its object-oriented programming environment, for large industrial projects. The Unix-based software is available in components, so you purchase only the tools and libraries you need. The components are EiffelBench, EiffelVision, EiffelBuild, EiffelStore, and EiffelBase.

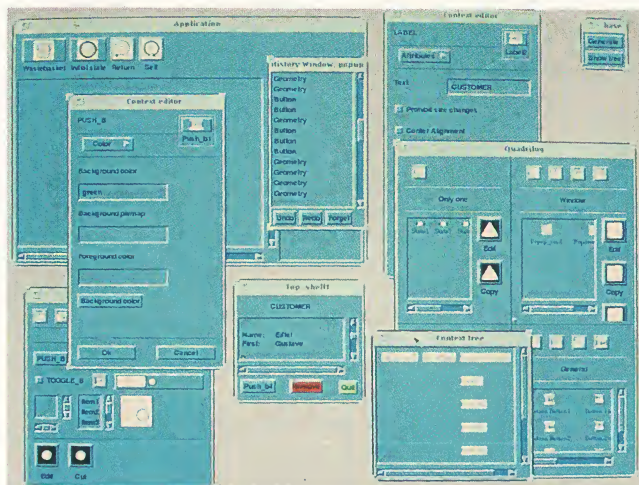
EiffelBench consists of the Eiffel compiler and object-oriented tools that let you debug, browse, edit, and cross-develop self-contained C packages and external language interfaces for languages like C. EiffelVision, a high-level GUI library with standard interface toolkits (Motif and OpenLook), lets you write applications in Eiffel for windowing environments without having to learn the details of the GUI toolkits and their C interfaces.

The EiffelBuild application builder generates the GUI and the links to the semantic actions and produces clear, bug-free, and maintainable Eiffel code. EiffelStore is the class library for interfacing with relational and object-oriented DBMSes. The module deals with high-level persistency and the storage and retrieval of networks of objects into and from databases using SQL (Structured Query Language). EiffelBase contains Eiffel libraries, which provide hundreds of reusable components.

Price: EiffelBench, \$995; additional tool sets and libraries, \$295 to \$1995.

Contact: Interactive Software Engineering, Inc., 270 Storke Rd., Suite 7, Goleta, CA 93117, (805) 685-1006; fax (805) 685-6869.

Circle 1305 on Inquiry Card.



ISE Eiffel 3, an object-oriented programming environment for industrial projects, combines the Eiffel language with advanced, user-friendly programming tools.

Generate C++ Code

If you are a Windows developer who uses Knowledge-Pro for Windows, now you can generate C++ code with the KPWin++ Windows Development Tool. The C++ code-generation facility lets you prototype applications using KPWin's (or Revelation Technologies' OpenInsight's) interactive design tools and underlying language. KPWin++ works with all the expert systems, hypertext, multimedia, list-handling, and file-handling capabilities of the KPWin language.

The package can read code written in the KPWin or OpenInsight environment and generate ANSI-standard compilable C++ code. Using the Microsoft C/C++ 7.0 compiler, you can amend the generated C++ code, link to third-party libraries, and then compile to create a high-performance executable file.

Price: \$895.

Contact: Knowledge Garden, Inc., 12-8 Technology Dr., Setauket, NY 11733, (516) 246-5400; fax (516) 246-5452.

Circle 1306 on Inquiry Card.

Build Your Own Pen Applications

Personal Pen Pal, a development environment for pen computers, helps you quickly build pen-centric applications or modify the provided applications templates for your own use. Using menu- and graphics-driven selections, you can design forms, define records and databases, program actions, specify communications and print operations, and test and run applications within a single environment. A syntax builder in the menu system virtually eliminates syntax errors and the need to remember names and symbols.

Personal Pen Pal runs under DOS or Windows on PCs with a 286 or higher CPU, a VGA monitor, and a Microsoft-compatible mouse.

Price: \$395.

Contact: Pen Pal Associates, Inc., 4970 El Camino Real,

Suite 200, Los Altos, CA 94022, (415) 903-3850; fax (415) 961-0995.

Circle 1308 on Inquiry Card.

3-D Graphics Toolkit with PHIGS+ and PEX

Liant Software says that its FIGt package is the first 3-D graphics toolkit to combine object-oriented programming with PHIGS+ and PEX (PHIGS Extension to the X Window System). The package lets you write 2-D and 3-D graphics applications with standard PHIGS+ APIs and run the software unchanged across systems from PCs to supercomputers.

FIGt provides a library of preprogrammed objects that contain information on generating and manipulating a given graphics object. It also provides features such as color management, viewing, lighting, shading, and structure ID management. The library can use PHIGS APIs to drive the PEX protocol, and it supports PEXlib, so you can develop distributed graphics applications with a higher-level programming interface than PEXlib alone can provide.

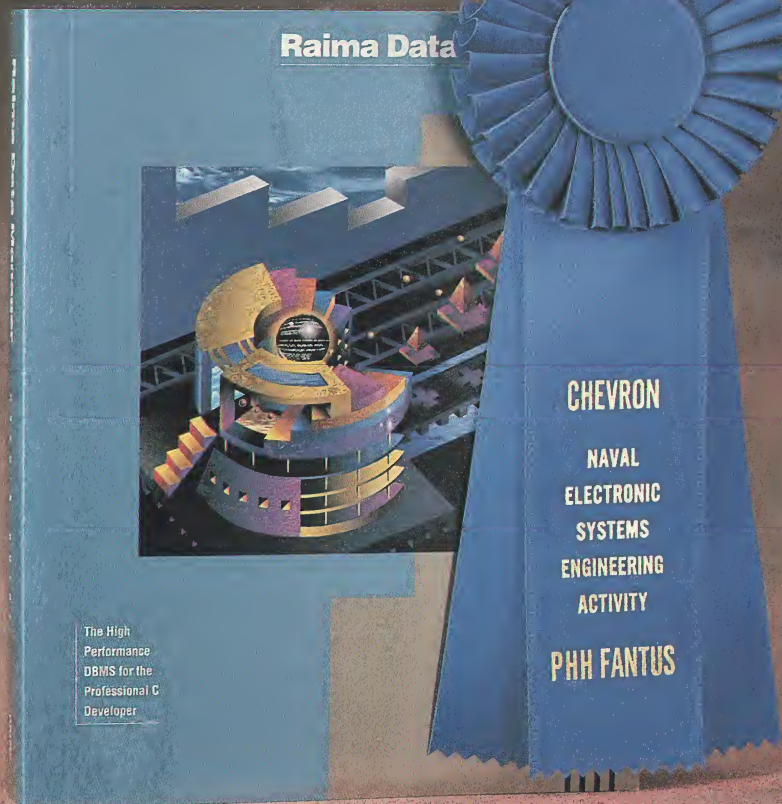
FIGt works with most PHIGS APIs (e.g., those from Sun Microsystems, DEC, Hewlett-Packard, and IBM), as well as with the company's Figaro+.

Price: \$1245 to \$2245.

Contact: Liant Software Corp., 959 Concord St., Framingham, MA 01701, (508) 872-8700; fax (508) 626-2221.

Circle 1307 on Inquiry Card.

Since when is Raima first in Corporate Database Development?



Since April 7, 1992

Raima Database Manager was the database of choice in the First Annual Windows World Open. The competition featured innovative custom applications built with Windows development tools. Three of the seven winners, and two of the finalists, used Raima Database Manager to solve their critical application needs.

For professional developers like yourself, Raima products offer:

- High performance: unmatched application speed.
- Portability: runs on DOS, Windows, OS/2, UNIX, VMS, QNX.
- Royalty-free distribution: increase your profits.
- Source-code availability: total programming flexibility.
- Affordable pricing: starting at just \$395.
- Language support: ANSI C, C++, and Visual Basic.

Listen to what some of our customers say about our products:

"No other products matched Raima for the price."

James Lisiak, developer, Chevron

"Raima provided us with speed, flexibility, and royalty-free distribution which allowed us to meet and exceed our customers' needs."

Dave Cooper, developer, Atlantic Research Corp,
(subcontractor, Naval Electronic Systems Engineering Activity)

"Database Manager gave us the edge we needed to handle large amounts of data quickly and efficiently within Microsoft Windows..."

Kelly Patrick, developer, PHH Fantus

If you're looking for an award-winning application development tool, give us a call. And discover the Raima advantage.

Raima Database Manager The high-performance DBMS
Raima Object Manager The object storage class library

Raima Corporation 1605 NW Sammamish Rd. Suite 200 Issaquah, WA 98027 (206)557-0200 Fax: (206)557-5200

1-800-DB-RAIMA Also available for DOS, OS/2, and UNIX

Copyright ©1992 Raima Corporation. All rights reserved.
BY112WA

Attention dBASE Users:

Can you run on UNIX* for only \$99.⁹⁵??

Now Available:
dBMAN V for COHERENT

Yes! Now you can with dBMAN V.
An exceptional offer. An
exceptional program.

dBMAN V is the most cost effective, portable dBASE compatible relational database management system on the market.

Now Available for COHERENT 4.0

dBMAN now runs under the world's best selling UNIX clone, COHERENT. With dBMAN and COHERENT, you can create powerful, multiuser XBASE solutions at a fraction of what you pay now.

Portability

dBMAN V let's you take your dBASE application and data, developed and created on one platform, and run them on another, in color, and without modification. Port to over 100 plus platforms and run right away. Platforms include: MS DOS, LAN, UNIX, Xenix, AIX, Sun, HP, COHERENT, mainframe and more.

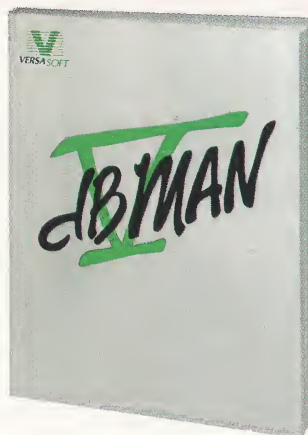
For end users, the time and money invested in applications is not lost when new platforms are added. For developers, software investments are protected and development efforts are leveraged to market your applications on other UNIX platforms.

ITEM	CATEGORY	ORDERDATE	REORDER	QTY:ONHD	UNITPRICE
NAVEL ORANGE	FRUIT	08/06/92	N	200	0.50
CHERRIES	FRUIT	07/23/92	N	150	0.75
SOURDOUGH	BREAD	08/21/92	N	557	0.78
CHICKEN:WHOLE	MEATS	06/30/92	N	35	1.65
STRAWBERRIES	FRUIT	07/21/92	N	15	0.92
T-BONE	MEATS	06/12/92	V	25	3.78
ENG-MUP				366	1.03
RAISIN:				470	0.67
FLOUR				999	1.09
SUGAR				3456	2.39
RICE				79	1.34
SOLE:PI				39	3.87
MILK:WH				30	1.07
BANANAS				70	0.45
BEANS				90	1.29
EGGS				45	0.99
CAKE:MI				1234	1.75
SHARK:F				10	1.99
APPLES				50	0.89
BUTTER				25	0.89
CHICKEN:THIGHS	MEATS	08/18/92	V	20	1.57
GRAPEFRUIT	FRUIT	09/10/92	V	13	0.98
VUBAN	COFFEE	09/05/92	N	50	2.35

The Most Productive Application Development System

dBMAN V's advanced design tools will enable you to build better applications faster. dBMAN V is based on the dBASE language with more than 300 language extensions. Features such as multiple procedure file, browse engine, push/pop windows, menus, nested GETs and more..., makes dBMAN V the most productive application development language in its class. **Circle 215 on Inquiry Card.**

All products mentioned in this advertisement are the registered trademarks of their respective owners.



Complete with Report Writer

dBMAN V includes a built-in, fully relational "band" style report writer with an easy-to-use "visual" interface. Create simple columnar reports or elaborate multi-line reports quickly without programming.

Cost Effective

Pay less for dBMAN V.. less than other dBASE products and much less than major RDBMS. Unlike other dBASE products, dBMAN V is licensed for an unlimited number of users. This all adds up to a significant savings for users, and a cost effective edge for developers.

An Exceptional Price for an Unlimited Number of Users**:

dBMAN V Coherent 4.0	\$ 99.95
dBMAN V SCO Xenix, UNIX 386.....	\$ 399.00
dBMAN V Sun SPARC.....	\$ 595.00
dBMAN V IBM AIX, RS/6000	\$ 895.00

Save Thousands of Dollars

Purchase dBMAN V and COHERENT for under \$200. **Save thousands of dollars on a complete development system for an UNLIMITED NUMBER OF USERS!**

OS:	COHERENT	\$99.95	SCO UNIX	\$ 2,590.00
DBMS:	dBMAN V	\$99.95	dBASE IV	\$ 2,995.00
Total:		\$ 199.90		\$ 5,585.00

The VersaSoft Commitment

VersaSoft has been producing high quality xBASE tools since 1983. We stand behind dBMAN V with a full **30 day money back guarantee** and great product support. Order dBMAN today at 408-723-9044.

Act Now! Call VersaSoft today at 408-723-9044 to order your copy of dBMAN V. Offer expires February 1, 1993.

* dBMAN V is available for most popular UNIX platforms and COHERENT (UNIX clone).

** Price includes a license for unlimited number of users on a single system.



VersaSoft Corporation
4340 Almaden Expwy, Ste. 110
San Jose, CA 95118

Tel: 408-723-9044
Fax: 408-723-9046

The World's Best Selling UNIX Clone Just Got Better.

Now with full 32-bit implementation!

If you want to ignite your 32-bit hardware with the multi-user, multi-tasking power of UNIX, Coherent 4.0 has arrived. And if you're operating or selling small business network systems with dozens of users, that's really good news. Because Coherent 4.0 is what you want in UNIX at a price that's hard to believe.

Run UNIX applications today!

Coherent is now binary compatible with UNIX. Most UNIX PC applications port with a simple recompile and many now run right out of the box. The list is growing everyday, so call for details.

Yes, It's For Real!

How can it be? First of all, Coherent was independently developed by the Mark Williams Company, so you don't pay for UNIX licensing fees. You don't pay any mark-up or reseller costs either. Coherent is only sold directly to you.

*"...(Coherent) may be the best thing that has happened to UNIX yet."
—William Zachmann, PC Week*

In fact, over 40,000 copies of Coherent have already been sold. And, like the ones we quote here, virtually every critic who's reviewed Coherent has raved about it.

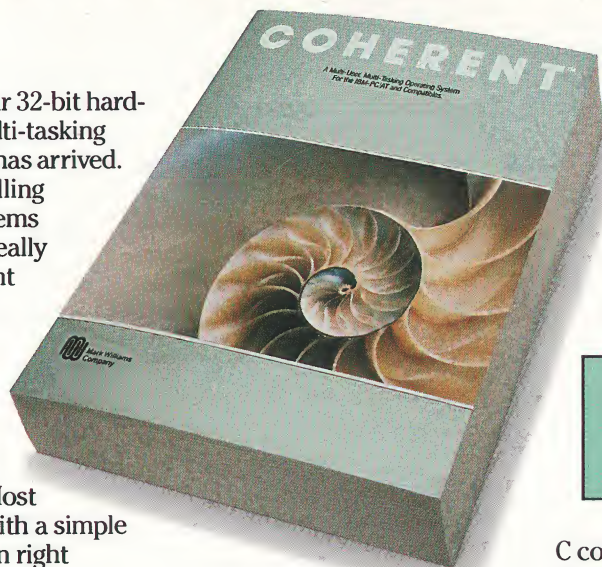
So Much Less, Yet So Much More.

As a virtual clone of UNIX, Coherent embraces the original UNIX philosophy: Small is beautiful. Small price, yes. But there's more, much more, to Coherent than its amazing price.

Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. And it runs with as little as 1 MB of memory versus 4 MB for other UNIX versions.

The World's Only Plug And Play UNIX Clone.

You'll have Coherent up and running with a fraction of the time and effort it takes for other UNIX versions. Our



six disk installation is a breeze compared to their 25. You'll also learn it faster and increase overall performance. All because Coherent is smaller, faster... and better.

Small, But So Complete.

Make no mistake, Coherent is a wholly professional development system. You get a complete

"Coherent comes so fully qualified as a UNIX clone, you find yourself thinking, 'I can't believe it's not UNIX.'"—Sean Fulton, UNIX Today!

C compiler, assembler and over 200 UNIX commands including full sets of functions for development, administration, maintenance and text processing.

Coherent also comes with UUCP capabilities that connect you to a world-wide network of free software, news and millions of UNIX users. And it's all clearly documented in Coherent's highly praised 1200 page manual.

Experienced, Supported, Guaranteed.

Mark Williams Company has been developing professional programming tools since 1976. Our commitment to our products and users is unsurpassed. Users applaud our popular BBS and the widely acclaimed telephone support they get free from Coherent developers.

Still, we're not asking you to take a chance on Coherent. We've made it fool-proof to see for yourself—with a 60-day money-back, no hassles guarantee. So pick up that phone and order Coherent now. And the best way to UNIX will be on its way to you!

800-MARK WMS

(800-627-5967 or 708-291-6700, FAX: 708-291-6750)

60-DAY MONEY BACK GUARANTEE!



Mark Williams Company

60 Revere Drive, Northbrook, IL 60062

Coherent is a trademark of Mark Williams Company. UNIX is a trademark of USL.

	MWC COHERENT Version 4.0	SCO UNIX/386 Version 3.2V2
No. of Manuals	1	14
No. of Disks	6	25
Kernel Size	100 K	375 K
Install Time	40 min.	3-4 hours
Suggested Disk Space	10 meg	60 meg
Min. Memory Required	1 meg	2-4 meg
Performance*	85.7	31.3
Price	\$99.95	\$2590

*Byte C Compiler Benchmark: Compiles per minute on 25 MHZ 486.

Staff Scheduling on the PC

Designed to automate the staff-scheduling process on a PC, the Universal Staff Scheduler takes into account employee availability, shift lengths, staff task abilities, and the employee's desired hours to help you figure out the right worker for the right job at the right time. You can determine employee availability by the quarter-hour, as well as schedule part-time employees.

The Universal Staff Scheduler provides an Employee Maintenance File where you store historical data (e.g., availability, birthdays, and vacations) and an Employee Exceptions File where you store unusual scheduling requests (e.g., National Guard duty). The package can handle up to 150 user-definable jobs or tasks and provides on-screen calculations of the actual labor cost and its percent of sales. In addition, the Universal Staff Scheduler can generate scheduling and analysis reports, monitor potential child labor law conflicts, and build a business history as a database.

Price: \$495.

Contact: Atlas Business Solutions, 3330 Fiechtner Dr. SW, Fargo, ND 58106, (701) 235-5226; fax (701) 280-0842.

Circle 1311 on Inquiry Card.

Use Your Sales Force Efficiently

Market-Base helps you build, maintain, and use databases of sales leads and customers to keep your sales force efficient. The package offers flexible look-up fields, a multilevel security system, an alarm system, call planning and reporting, quotation management, lead tracking, analysis of sales-area perfor-

	Sales				Scheduled				Labor \$				Labor %			
	4212.34				186.58				698.75				16.398			
	Monday 8:00-11:00															
	10	11	12	13	14	15	16	17	18	1	HRS					
R Repair	F	FFFF	FFFF	FFFF	FFFF	FFFF	FFFF									7.00
Sharon Adams	S	SSSS	SSSS	SSSS	SSSS	SSSS	SSSS									6.50
Sarah Jones	B	BBBB	BBBB	BBBB	BBBB	BBBB	BBBB									6.00
Debbie Dolder																0.00
David Smith																0.00
John Jones																0.00
Roger Craig																0.00
Randy Gonzalez																0.00
Laura Wisman																0.00
SCHEDULED																0.00

The Universal Staff Scheduler solves your staff-scheduling problems and creates an information base that lets you track your performance history.

mance, a built-in word processor, and analysis of promotional campaign effectiveness, market segmentation, and competitors.

For sales project planning, the Multiple Future Actions feature lets you attach to each contact an unlimited number of actions to be taken to alert you to each stage of the customer's purchasing decision process. With the Field Label Tailor feature, you can modify data fields and determine which customer information to keep. The Action View option lets you access contact records in date order of action required. You work directly from a To Do list, noting the results of each event and setting the next action date. Market-Base also lets you separate prospective and actual customers, moving companies from one data area to another.

Market-Base is available for single-user PCs, for a multiuser network, or in distributed mode for field sales staff on portable PCs.

Price: Entry-level system starts at about \$1130 (£595).

Contact: Kensington Marketing Systems, 6/51 Drayton

Gardens, Kensington, London SW10 9RX, U.K., phone and fax 44-71-373-5746.

Circle 1312 on Inquiry Card.

Manage Personnel on the Mac

OrgChart Express for the Macintosh integrates two areas of personnel management: the display of a reporting structure and the administration of employee and job-related information. By connecting tiles (i.e., graphical boxes) containing personal and job-related data, you can visually define reporting structures while maintaining the integrity of the tile data.

You specify data fields as tied to either the personal or position information as represented by the tiles. This lets you move employees to different positions while leaving previous job-related data intact. For special projects, you can assign multiple positions to one person and still maintain the integrity of his or her personal data.

OrgChart Express also includes searching and sorting by any data field, importing and exporting text data, displaying functions with numerous name formats and tile and line styles, and color and gray-scale support.

Price: \$279.

Contact: Kaetron Software Corp., 12777 Jones Rd., Suite 445, Houston, TX 77070, (713) 890-3434; fax: (713) 890-6767.

Circle 1314 on Inquiry Card.

Data 2.0 Helps You Make Decisions

TreeAge Software has added financial and mathematical functions, annotation, TrueType font control, and exporting of graph data to spreadsheets and trees to Data 2.0, the System 7.0 version of its graphical decision-analysis software for the Mac. Version 2.0 also includes Apple events, Publish/Subscribe for spreadsheets and word processors, print preview, and improved tree display, manipulation, calculation, and printing.

You can use Data 2.0 for strategic and tactical decision making, risk assessment, determining settlement values in complex litigation, and medical triage. The package provides two mechanisms for drawing the decision tree: You can generate a tree, including branch names and numeric probabilities, by converting a hierarchical outline that you type in Data or import from a word processing or outline program, or you can construct a tree on-screen by adding branches or by copying a subtree at decision or chance nodes that you have selected.

Price: \$495.

Contact: TreeAge Software, Inc., 1 Post Office Sq., 23rd Floor, Boston, MA 02109, (617) 426-5819; fax (617) 338-2880.

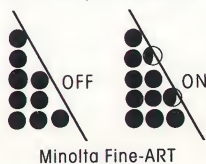
Circle 1313 on Inquiry Card.

This printer knows how precious your time is.



New from Minolta: Laser Printer SP3500.

See for yourself how the new Laser Printers SP3500 and SP3000 can be real time-savers in your business. Thanks to powerful RISC technology (AMD's 29K[®] ¹ family) they feature extremely fast data-processing speed, giving the least possible delay between data transfer and printing. You get 10 pages per minute in a superb print quality. The unbeatable combination of Minolta Fine-ART (Advanced Resolution Technology), the brilliant Micro-Toning System, Truelmage[™] ² software (standard for SP3500 and optional for SP3000), Font Flexibility and Multi-Emulation. So ... don't waste a second making up your mind.



Fax · Copiers · Laser Printers

Minolta. The simplicity of intelligence.



Minolta GmbH · B.E.O. · In den Kolkwiesen 68 · D-3012 Langenhagen 1 · Tel. (05 11) 77 00-0

¹ 29K[®] is registered trade mark of Advanced Micro Devices, Inc. ² Truelmage[™] is trade mark of Microsoft[®] Corp.

Circle 409 on Inquiry Card.

NOVEMBER 1992 · BYTE 99

90W psu (150W on B-series), unique mains/standby power switch combination

Choice of Slimline M or Compact B case

Choice of interlaced and non-interlaced, low radiation, MPR II colour SVGA or mono VGA monitor

Keyboard, mouse, MS-DOS 5.0, Windows 3.1

Universal Motherboard

2MB RAM (max 32MB) for 486SX CPUs
4MB RAM (max 32MB) for 486DX CPUs
VGA 512k upgradeable to 1MB Video RAM advanced graphics connector, 1 parallel 2 serial ports

Processor Cards

PC-466: 66MHz 486DX2, 64k cache (max 1MB)

PC-450: 50MHz 486DX2, 64k cache (max 1MB)

PC-433: 33MHz 486DX, 64k cache (max 1MB)

PC-425X: 25MHz 486SX, 64 cache (max 1 MB)

PC-420X: 20MHz 486SX, 8k internal cache

WAC 92 Windows Accelerator Card

S3-based windows accelerator, VGA compatible, up to 1280 x 1024 pixels, 1MB Video Ram, 256 from a palette of 262,000 colours

Advanced Colour Monitors

1280 x 1024 pixels, interlaced and non-interlaced, XV17: 17", XV20: 20" Trinitron.

Sample Colour Price

NEW POWER OPTION
PC-466M

4MB RAM, 66MHz, 486 DX2

£ 1 5 9 5

512k Video RAM	Colour VGA	S3 VGA Windows Accelerator	XV17	XV20
PC-466M	£1,595	£2,080	£2,250	£3,000
PC-450M	£1,395	£1,880	£2,050	£2,800
PC-433M	£1,175	£1,660	£1,830	£2,580
PC-425XM	£895	£1,380	£1,550	£2,300
PC-420XM	£795	£1,280	£1,450	£2,200

90W psu (150W on B-series), unique mains / standby power switch combination.
For B model ADD £40

Hard Disk options

100MB ide	Add £70	400MB scsi	Add £865
200MB ide	Add £250	1.0 GB scsi	Add £1,465
400MB ide	Add £650	1.4 GB scsi	Add £1,965

Each Elonex PC comes ready to use with MS-DOS and Windows 3.1 installed and is backed up by our Technical Support Hotline (081-452 6666) Response Computer Maintenance (081-965 3225) provide the first year's on-site maintenance free of charge, with subsequent years priced at 8% of the original invoice (min. £75).

Elonex is a registered trade mark of Elonex plc. MS-DOS and Windows are trademarks of Microsoft Inc. The Intel Inside logo, and the Intel486™ are trademarks of Intel Corporation.

All prices and specifications are subject to change without notice.

Elonex plc, 2 Apsley Way, London NW2 7LF
Tel 081-452 4444
Fax: 081-452 6422

Elonex plc, 7-9 Campus Road, Listerhills Science Park, Bradford BD7 1HR.
Tel 0274-307226
Fax: 0274-307294

Elonex (France) s.a.r.l., Paris, France
Tel (1) 40.85.85.40 Fax (1)40.85.84.83

Elonex (Benelux) sa/nv, Brussels, Belgium
Tel (02) 675.19.20 Fax (02) 675.34.00

ERS Computers, Dublin, Eire
Tel 01-6797554 Fax 01-6791728

ELONEXH



Who else but Elonex could bring you a PC to satisfy your thirst for computing power without scorching your bank balance.

High quality PCs, all upgradeable from a 20MHz 486SX, to an amazing 66MHz, at prices which other manufacturers will find hard to match.

Our British-made PCs are built to the highest standards and supported by an after sales service that includes FREE on-site maintenance for the first year.

Quality, choice and value for money have made Elonex the U.K's leading direct PC seller.

Quench your thirst, call Elonex now on 081 452 4444.

LARATION



ELONEX

**PERSONAL
COMPUTERS**

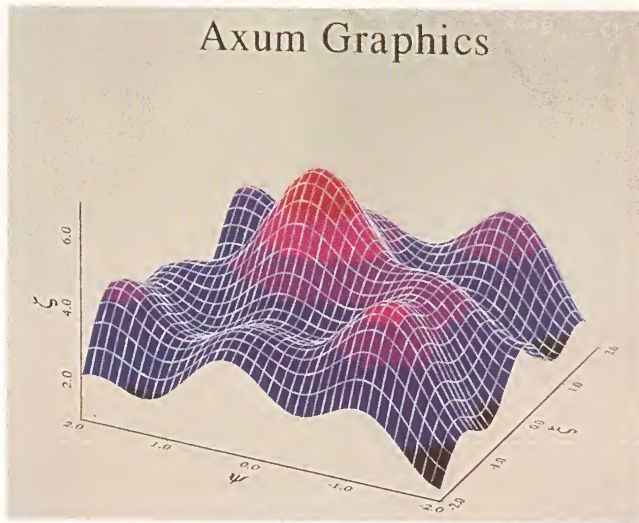
Automate Data-Analysis Tasks

The latest version of Axum, a technical graphics and data analysis package for the PC, provides batch-processing features that you use to automate repetitive graphical and data-analysis tasks. Axum 2.0 also offers automatic axis scaling and intelligent tick-placement methods that help you create publication-quality graphs.

With version 2.0's advances in 2-D, 3-D, and contour plotting, you can plot 3-D mesh-surface plots of any size, draw 3-D grids on any plane at any position, draw reference lines anywhere on a graph, and use color shading for 3-D surfaces and splines. You also get additional curve-fitting plot types; labeled scatter plots; PostScript fonts; support for TIFF, Color PostScript, and HPGL2; and the ability to use matrix data for grouped bar charts, grouped box plots, and 3-D.

Axum 2.0's data editor lets you sort multiple columns of data of any size, perform block operations, evaluate arbitrary functions, and sort on unlimited-size data sets. Axum 2.0 automatically uses EMS, XMS, and the high-memory area.

Price: \$495.
Contact: TriMetrix, Inc., 444 Northeast Ravenna Blvd., Suite 210, Seattle, WA 98115, (206) 527-1801; fax



Scientists and engineers can have Axum 2.0 automatically load new data and update a set of graphs on a regular basis.

(206) 522-9159.
Circle 1318 on Inquiry Card.

Scientific Data Analysis and Visualization

IDL for Windows provides a single distributed environment that lets scientists and engineers share programs, data, and computing resources transparently. You can use the package for applications such as physics, astronomy, image and signal processing, remote-sensing medical imaging, and financial analysis.

The Windows version includes all the capabilities of the workstation versions. Features include IDL/Win-

gets, a GUI toolkit for building custom applications interfaces; 2-D plotting; 3-D visualization; IDL/maps, which lets you create sophisticated mapping and remote-sensing applications; IDL/gridding, which lets you fit irregularly gridded data to a regular grid for use with IDL's plotting and visualization capabilities; and IDL/statistics, a library of statistical routines for data analysis.

IDL for Windows also provides routines for 10 mapping projections with inverses, gridding, and image warping and quintic interpolation (a smoothing algorithm). You can display complex 3-D objects using z-buffered graphics and iso-surfaces.

Price: \$1500.
Contact: Research Systems, Inc., 777 29th St., Suite 302, Boulder, CO 80303, (303) 786-9900; fax (303) 786-9909.

Circle 1322 on Inquiry Card.

Statistics and Graphics for the Mac

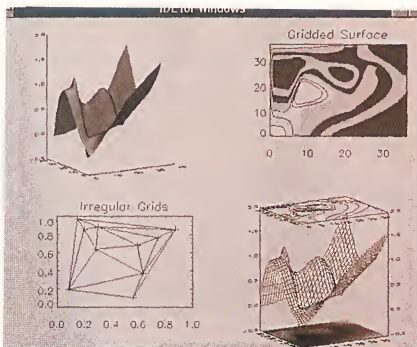
Systat has added statistical analyses, graphics features, and data-handling features to Fastat 2.0 for the Mac. The software lets you view data, analysis results, and graphics simultaneously in several windows, and it dynamically links data and graphics, so you can select points in a chart or graph and immediately view corresponding cases in Fastat's spreadsheet-like data editor.

Fastat 2.0 can analyze up to 150 variables with an unlimited number of cases. Statistical analyses include basic descriptive statistics, correlations, factor analysis, regression, analysis of variance, nonparametric statistics, and time-series analyses. Graphics options include 3-D and 2-D scatter plots, bar charts, pie charts, category plots, box-and-whisker plots, stem-and-leaf plots, scatter-plot matrices, and probability and function plots. Fastat 2.0 is 32-bit QuickDraw-compatible, so you can select a broad range of colors for your graphics, and it supports the QuickTime system software extension, which lets you view a series of Fastat plots or graphs as an animated movie and watch how data changes over time.

Data-handling features include numeric and character data types and nested sorts; complex numeric transformations; random number, distribution, and density functions; importing of Microsoft Excel and ASCII files; and exporting of ASCII files.

Price: \$495.
Contact: Systat, Inc., 1800 Sherman Ave., Evanston, IL 60201, (708) 864-5670; fax (708) 492-3567.

Circle 1319 on Inquiry Card.



Ported from workstation-based hardware to the PC environment, IDL for Windows lets scientists and engineers perform high-powered scientific computing on low-cost machines.

PROTECT YOUR SOFTWARE



NO BUTTON, NO ACCESS.

Dallas Semiconductor is re-shaping the world of software protection and distribution control with a new family of microchips called Authorization Buttons.

Put a Lid on It

We put the lid on software piracy by packaging microchips in button-shaped, stainless steel cans. The chips contain missing but critical information to make the software run. Execution rights are determined by possession of the Authorization Button. And thanks to the high-volume, low-cost nature of canning, Buttons are the lowest cost way to protect software.

Lock Your Button, Name Your Price

We offer a variety of Authorization Buttons and features so you can select the level of protection and price point that are right for you.

Current offerings include a laser-engraved serial number, a memory with an expiration date, and a multi-level, password-protected memory.

Security Continuum

Button Type	Unique Serial #	Read/Write Memory	Password Protection	Expiration Timer	Decoy Responses
DS1420 ID Button	X				
DS1427 Timer Button	X	4K bits		X	
DS1425 Multi Button	X	2K bits	X		X

Encourage the Trial

With the DS1427 Time Button, you can actually encourage software trials (and still sleep at night). Trial or lease plans can be based on calendar time, elapsed time, or the number of times an application has been accessed. When the trial period that you specify is up, the software no longer functions.



**DALLAS
SEMICONDUCTOR**

Snap In, Snap Out

Buttons interface to the PC's parallel port via the DS1410 Button Holder. They simply snap in and out. So an inexpensive Button can be sent out for a new release, a security update, or a lease extension. Each Button Holder accepts two buttons, so your customers don't have to piggy-back dongles to protect multiple packages.

The future will be a dongleless world. New computers that accept Buttons directly, including palm and notebooks, are being designed at OEM's today. Buttons are not parallel port-dependent.

Software Protection with Complete Compatibility

Dallas Semiconductor Buttons are compatible across all ISA, EISA, and MCA machines — on underpowered notebooks as well as the anti-compatible Brand X's. We achieve this total compatibility through microchips that are self-powered, unlike other protection devices that must draw power from the host machine.

Made in the U.S.A.

At Dallas Semiconductor, we design *and* manufacture our own microchips. And we're the only ones in the software protection business who do. Sixty intricate process steps and a 64-bit unique serial number lasered into each chip prevent duplication.

To learn how to button down your software, give us a call.

FREE!
Authorization Button.
Call 800-258-5061

4401 South Beltwood Parkway, Dallas, Texas 75244-3292 Telephone: 214-450-0448 FAX: 214-450-3715

Circle 255 on Inquiry Card.

Medical Visualization with QuickTime

Evergreen Technologies offers two groups of software modules, called the Ciné Loop Module Set and the Nuclear Option Pak, for medical professionals to use with MedVision, the medical visualization environment for the Mac, and QuickTime to animate medical images.

The Ciné Loop Module Set lets you create, animate, and manipulate medical images, and the Nuclear Option Pak adds the ability to select from a variety of image color palettes and the ability to animate multiple images in a snake ciné loop.

Both packages include QuickTime extensions that let you create and view Med-Vision movies in the Med-Vision environment. You can also import other QuickTime movies into MedVision with full support for copy and paste functions and sound.

Price: Ciné Loop Module Set, \$395; Nuclear Option Pak, \$595.

Contact: Evergreen Technologies, Inc., Diamond Farm Office Park, 849-M Quince Orchard Blvd., Gaithersburg, MD 20878, (301) 948-1800; fax (301) 990-6844.

Circle 1324 on Inquiry Card.

Multimedia Presentations for SPARC

IslandPresents, a multimedia presentation and business graphics package for Unix, is now available for



Using the Ciné Loop Module Set and the Nuclear Option Pak with QuickTime, radiologists can rapidly analyze sequences of images to determine areas that require closer examination.

SunSoft's Solaris software environment. The WYSIWYG package helps you quickly organize your ideas into overhead presentations, on-screen presentations, 35mm slides, and color handouts. You can create full-color presentations containing up to 16.7 million colors, including 256-color raster graphics, and illustrate your presentations with clip art from IslandPresent's library of over 1100 images. IslandPresents also comes with 90 professionally designed presentation templates and 35 PostScript fonts; you can also add your own Type 1 fonts. You can annotate them with music or voice segments recorded with SunSoft's Audio Tool.

The package also includes charting, table-editing, and painting modules. With the

charting features, you can create more than 16 types of data-driven color business graphics with multiple data sets, including bar, pie, and line charts, as well as symbol and x, y charts. You can import data from Lotus 1-2-3 or ASCII data files and generate single or multiple charts automatically from any portion of the data.

IslandPresents offers conversion utilities for graphics in Sun Raster, MacPaint, Group 3 fax, X Window System 11 bit-map, X Dump, and GIF formats.

Price: Single-user network license, \$995.

Contact: Island Graphics Corp., 4000 Civic Center Dr., San Rafael, CA 94903, (415) 491-1000; fax (415) 491-0402.

Circle 1325 on Inquiry Card.

Desktop Video Production on the Mac

Avid Technology's Media Suite Pro lets you create, edit, view, and record high-quality digital video on your Mac Quadra. The desktop video production system can combine video, graphics, animation, titles, scanned images, electronic photos, and music and other sound effects into full-screen, full-motion, TV-quality video on your Mac's hard disk.

You can output a single video presentation in any of three formats without additional hardware and software and immediately view the presentation on the computer under interactive control; directly record it from the computer onto videotape in real time; or distribute it as a QuickTime movie.

Media Suite Pro lets you import and export graphics, animation, and audio files in formats such as PICT, PICS, and AIFF. In addition, programs you start on Media Suite Pro can track SMPTE time code, and you can transfer them to Avid's Media Composer digital nonlinear editing system using the Open Media Framework interchange.

The package includes the Media Suite Pro software; video, JPEG compression, and audio boards; a SCSI-2 drive controller; and stereo amplified speakers with CD-quality sound.

Price: Under \$14,000.

Contact: Avid Technology, Inc., Metropolitan Technology Park, 1 Park West, Tewksbury, MA 01876, (508) 640-6789; fax (508) 640-1366.

Circle 1326 on Inquiry Card.

SPREAD THE WORD

Please address new product information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.hw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.

HOT!
386 VERSION.



JUST HOW FAST IS PROGRAMMING IN APL★PLUS?

This fast. APL★PLUS streamlines the whole programming process and screams through complex data manipulations with turbo speed.

APL★PLUS notation is like the math you already know. So you can solve problems the way you think about them, instead of wasting time figuring out *how* to solve them. And it's concise. A few lines of APL★PLUS can replace pages of code written in other languages.

Explore complex "what if" scenarios using built-in functions that manipulate tables of data like single objects. Prototype solutions and quickly put them to the test. Develop complete applications in record-breaking time with editing, graphics, screen windowing and communications facilities, mouse support and interfaces to spreadsheets and subroutines written in other languages.

Use our tutorial to jump start the whole programming process. Then, use APL★PLUS' speed and power to zoom through your development cycle so fast it's almost illegal. APL★PLUS. The programming language to use when you have miles of data. And the need for speed. Call today and we'll rush you a *free* demo disk.

APL★PLUS®
(800) 592-0050 Ext. 875

In Maryland (301) 984-5123

APL★PLUS is a registered trademark of Manugistics, Inc., and is available for IBM PC's and compatibles, UNIX workstations, VAX minicomputers and IBM mainframes. Fax: (301) 984-5094 TELEX: 898085 (STSC ROVE) © 1991 STSC, Inc. Germany: 069-80053-0/0212-33-90-99; France: 01-45-27-20-61; U.K.: 071-436-9481; Canada: 416-369-1630; Spain: 01-556-6056. All other countries, call (301) 984-5412 for the name of a local dealer.

Circle 186 on Inquiry Card

Osborne/McGraw-Hill Computer Books Are Available At These Fine Stores

ALABAMA

Birmingham, AL
Jonathan Benton Bookseller
PH: 205-967-8840
FAX: 205-967-9812

Smith & Hardwick Bookstore
PH: 205-591-9970

Huntsville, AL
University Bookstore
PH: 205-895-6600

Madison, AL
Madison Books & Computers
PH: 205-772-9250
FAX: 205-461-8076

Tuscaloosa, AL
University Supply Store
PH: 205-348-6126

CALIFORNIA

Berkeley, CA
Cody's Books
PH: 510-845-7852

Whole Earth Access
PH: 510-845-3000

Capitola, CA
Capitola Book Cafe
PH: 408-462-4415

Chino, CA
Mr. B's Computer Books
PH: 714-464-2777
FAX: 714-464-2779

Citrus Heights, CA
Tower Books
PH: 916-961-7202

Concord, CA
Whole Earth Access
PH: 510-686-2270

Cupertino, CA
A Clean Well Lighted Place
PH: 408-255-7600

Computer Literacy Bookshops
PH: 408-973-9955

Stacey's Bookstore
PH: 408-253-7521

Davis, CA
UCD Bookstore
PH: 916-752-2944
FAX: 916-752-4791

Irvine, CA
Irvine Sci-Tech Books
PH: 800-229-9514
FAX: 714-733-0122

Long Beach, CA
Forty-Niner Shops
PH: 310-985-5093
FAX: 310-985-1593

Los Angeles, CA
OPAMP Technical Books, Inc.
PH: 800-468-4322
FAX: 213-464-0977

Technical Book Company
PH: 310-475-5711

UCLA Students Store
PH: 310-206-0763

Mountain View, CA
Printer's Inc.
PH: 415-961-8500

Palo Alto, CA
Printer's Inc.
PH: 415-327-6500

Stacey's Bookstore
PH: 415-326-0681

Stanford Bookstore
PH: 415-327-3680

Sacramento, CA
Hornet Book Store
PH: 916-278-5687

Whole Earth Electronics
PH: 916-489-1000

San Diego, CA
San Diego Technical Books, Inc.
PH: 800-346-0071
FAX: 619-279-5088

San Francisco, CA
Stacey's Bookstore
PH: 415-421-4687

Whole Earth Access
PH: 415-285-5244

San Jose, CA
Computer Literacy Bookshops
PH: 408-435-1118

Whole Earth Access
PH: 408-554-1500

San Mateo, CA
Whole Earth Access
PH: 415-578-9200

San Rafael, CA
Whole Earth Access
PH: 415-459-3533

Santa Barbara, CA
Chaucer's Bookstore
PH: 805-682-6787
FAX: 805-682-1129

UCSB Bookstore
PH: 805-893-2082

Stanford, CA
Stanford Bookstore
PH: 415-329-1217

Sunnyvale, CA
Computer Literacy Bookshops
PH: 408-730-9955

COLORADO

Boulder, CO
United Techbook Co.
PH: 303-443-7037

University Book Center
PH: 303-492-6411

Denver, CO
Auraria Book Center
PH: 303-556-3230

The Tattered Cover
PH: 303-322-7727

United Techbook Co.
PH: 303-534-3460

Englewood, CO
SoftPro Books
PH: 303-740-7751
FAX: 303-740-8152

Longmont, CO
United Techbook Co.
PH: 303-651-3184

CONNECTICUT

New Haven, CT
Yale Co-Op
PH: 203-772-2200
FAX: 800-354-9253

Stoors, CT
U-Conn Co-Op
PH: 203-486-3537

DELAWARE

Newark, DE
McMahon Books
PH: 302-366-7575

University of Delaware Book Store
PH: 302-831-2637

DISTRICT OF COLUMBIA

Washington, DC
Micro Center
PH: 703-204-8409
FAX: 703-204-8408

Olsson's Books
PH: 202-338-9544

Reiter's Scientific & Professional Books
PH: 202-223-3327
FAX: 202-296-9103

Reprint Book Shop
PH: 202-554-5070

FLORIDA

Coral Gables, FL
Softhouse
PH: 305-446-7638

University of Miami Bookstore
PH: 305-284-4101

Gainesville, FL
University Book & Supply
PH: 904-377-1788

University of Florida Bookstores
PH: 904-392-0194

Miami, FL
Downtown Book Center
PH: 305-377-9939

Orlando, FL
It's Academic
PH: 407-658-4612

Sarasota, FL
Paperback Booksmith
PH: 813-922-5000

Tampa, FL
The Monocle Bookshop
PH: 813-879-5728

GEORGIA

Atlanta, GA
Engineers Bookstore
PH: 800-635-5919
FAX: 404-892-5838

Georgia Tech Bookstore
PH: 404-894-2515

Oxford Bookstore
PH: 404-262-3333

Marietta, GA
Micro Center
PH: 404-859-1545
FAX: 404-859-1559

HAWAII

Honolulu, HI
Honolulu Book Shops
Ala Moana Shopping Center
PH: 808-941-2274

Honolulu Book Shops
Bishop & Hotel Street
PH: 808-537-6224

University of Hawaii Bookstore
PH: 808-956-4338
FAX: 808-956-4338

IDAHO

Moscow, ID
University of Idaho Bookstore
PH: 208-885-6482

ILLINOIS

Chicago, IL
Kroch's & Brentano's
PH: 800-833-B00K
FAX: 312-332-6074

KANSAS

Lawrence, KS
The C User's Bookstore
PH: 913-841-1631
FAX: 913-841-2624

KENTUCKY

Bowling Green, KY
College Heights Bookstore
PH: 502-745-5799

Lexington, KY
Joseph Beth Booksellers
PH: 606-271-5330
FAX: 606-272-6948

Kennedy Bookstore
PH: 606-252-0331

Louisville, KY
University of Louisville Bookstore
PH: 502-588-6679

Morehead, KY
Morehead State University Bookstore
PH: 606-783-2081

MAINE

Orono, ME
University of Maine Bookstore
PH: 207-581-1700
FAX: 207-866-2836

MARYLAND

College Park, MD
Maryland Book Exchange
PH: 301-927-2510
FAX: 301-209-7118

University Book Center
PH: 301-454-3222

MASSACHUSETTS

Boston, MA
Boston University
PH: 617-267-8484
FAX: 800-353-5531

Northeastern University Bookstore
PH: 617-437-2286

Waterstone's Booksellers
PH: 617-859-8030
FAX: 617-859-8038

Burlington, MA
Soft Pro
PH: 617-273-2919
FAX: 617-273-2499

Cambridge, MA
Harvard Coop
PH: 617-499-2000

MIT Coop
PH: 617-499-3230
FAX: 617-621-0856

Quantum Books
PH: 617-494-5042
FAX: 617-577-7282

WordsWorth at Harvard Square
PH: 617-354-5201

Westborough, MA
Open Book
PH: 617-366-8448

Worcester, MA
Tatnuck Bookseller
PH: 508-756-7644
FAX: 508-756-9425

MICHIGAN

Ann Arbor, MI
Ulrich's Bookstore
PH: 313-662-3201

East Lansing, MI
Jocundry's Books
PH: 517-332-0856

Michigan State University Bookstore
PH: 517-355-3454

Student Book Store
PH: 517-351-4210

Flint, MI
Young & Welshan's
PH: 313-732-0620

(continued after advertisement on next page)

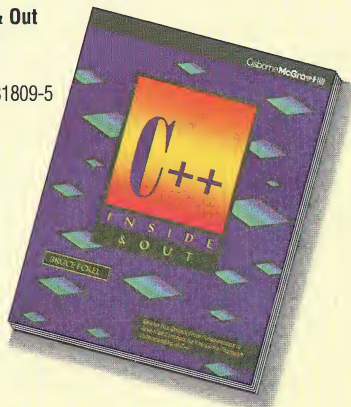
HOT

...Books to Get Your Programming Down Cold

For Comprehensive, Accurate Coverage, Choose Computer Books from Osborne

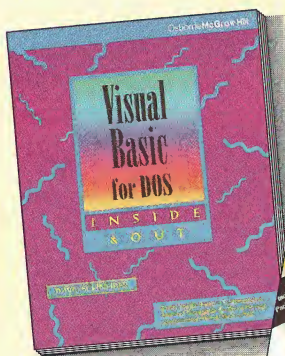
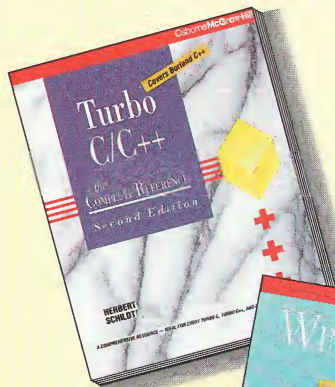
C++ Inside & Out
by Bruce Eckel

\$27.95
ISBN: 0-07-881809-5

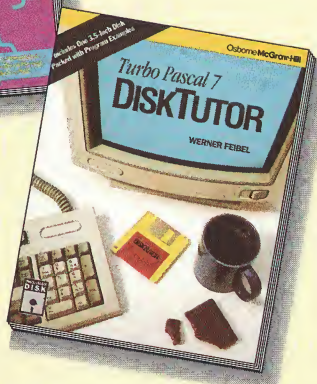


Turbo C/C++®: The Complete Reference, Second Edition
by Herbert Schildt

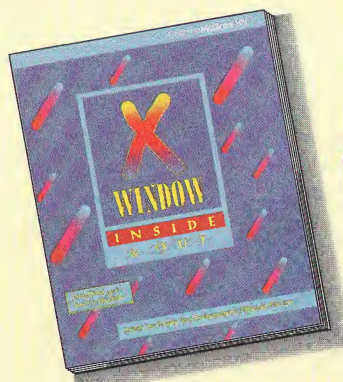
\$29.95
ISBN: 0-07-881776-5



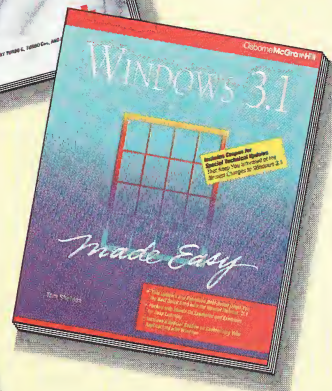
Visual Basic® for DOS Inside & Out
by David Schneider
\$29.95
ISBN: 0-07-881829-X



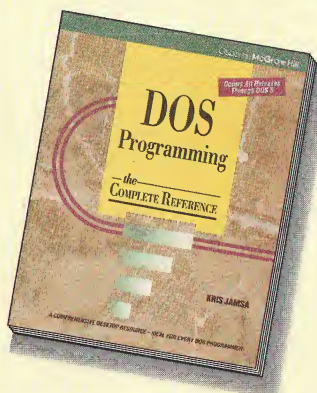
Turbo Pascal® 7 DiskTutor
by Werner Feibel
\$39.95, Book/Disk,
ISBN: 0-07-881799-4



X Window® Inside & Out
by Levi Reiss and Joseph Radin
\$27.95
ISBN: 0-07-881796-X



Windows® 3.1 Made Easy
by Tom Sheldon
\$19.95
ISBN: 0-07-881725-0



DOS Programming: The Complete Reference
by Kris Jamsa
\$29.95
ISBN: 0-07-881782-X

Osborne's outstanding computer books address all your programming needs. Get a fast start with new software by following our step-by-step DiskTutor and Made Easy guides. For detailed coverage of intermediate and more advanced programming tech- for all your programming questions, The Complete Reference series is matchless. Check out these RED HOT computer books and other fine Osborne titles.

Osborne 

Copyright © 1992 McGraw-Hill, Inc.

AVAILABLE NOW AT YOUR LOCAL BOOK OR COMPUTER STORE

Osborne/McGraw-Hill Computer Books Are Available At These Fine Stores

 (see advertisement on previous page)

MINNESOTA

Minneapolis, MN
Baxter's Books
PH: 612-339-4922
FAX: 612-339-4922

MISSISSIPPI

Mississippi State, MS
MSU Bookstore
PH: 601-325-2247

Oxford, MS
Ole Miss Bookstore
PH: 601-232-7131

MISSOURI

Columbia, MO
University Bookstore,
University of Missouri
PH: 314-882-7611
FAX: 314-882-6422

St. Louis, MO
The Library, Ltd.
PH: 314-727-8834
FAX: 314-727-0478

Software Plus
PH: 314-434-3311
FAX: 314-434-0524

Washington University Bookstore
PH: 314-935-5696

MONTANA

Bozeman, MT
MSU Bookstore
PH: 406-994-5844

NEBRASKA

Lincoln, NE
Nebraska Bookstore
PH: 402-476-0111
FAX: 402-476-0111

NEW HAMPSHIRE

Hanover, NH
Dartmouth Bookstore
PH: 800-462-9009 (NH only)
800-624-8800 (USA)

NEW JERSEY

Hightstown, NJ
McGraw-Hill Book Store
PH: 609-924-5750
FAX: 212-512-4105

Princeton, NJ
Princeton University Store
PH: 609-921-8500
FAX: 609-924-9651

Newark, NJ
Newark Book Center
PH: 201-642-7956

New Brunswick, NJ
Rutgers University Book Store
PH: 908-246-8448

NEW MEXICO

Albuquerque, NM
Page One
PH: 505-294-2026

NEW YORK

Buffalo, NY
SUNY Buffalo
PH: 716-636-3131

Ithaca, NY
Cornell Campus Store
PH: 607-255-2934

Triangle Book Store
PH: 607-272-7111

New York, NY
Classic Book Store
PH: 212-466-0668

Coliseum Book Store
PH: 212-581-5352

McGraw-Hill Book Store
PH: 212-512-4100
FAX: 212-512-4105

New York University Book Center
PH: 212-998-4666

Papyrus Books
PH: 212-222-3350

Rockwell Computer & Software
PH: 212-949-6935
FAX: 212-949-1252

Niagara Falls, NY
Book Corner
PH: 716-285-2928

Rochester, NY
Campus Connections Bookstore
PH: 716-475-2501

Maplewood Books
PH: 716-254-0621

World Wide News
PH: 716-546-7140

NORTH CAROLINA

Chapel Hill, NC
Bull's Head Bookshop
PH: 919-962-2420

Intimate Bookshop
PH: 919-929-0414
FAX: 919-967-2107

Charlotte, NC
Intimate Bookshop,
Southpark Mall
PH: 704-366-6400
FAX: 704-362-1200

Charlotte, NC (cont.)
Intimate Bookshop,
University Place
PH: 704-547-7400
FAX: 704-547-1107

Little Professor Book Center
PH: 704-527-0706

Durham, NC
Duke University —
Gothic Bookshop
PH: 919-684-3986

Greenville, NC
East Carolina University Student Stores
PH: 919-757-6731

Raleigh, NC
North Carolina State Univ. Bookstores
PH: 919-515-3573

Winston-Salem, NC
Intimate Bookshop
PH: 919-768-6400
FAX: 919-768-3127

OHIO

Beachwood, OH
Booksellers
PH: 216-831-5035

Chagrin Falls, OH
The Inside Story Book Shop
PH: 216-543-8168

Cincinnati, OH
Univ. Of Cincinnati Bookstore
PH: 513-556-1700

Cleveland, OH
Case Western Reserve Univ. Bookstore
PH: 216-368-2650

Columbus, OH
Long's College Bookstore
PH: 614-294-4674

Micro Center
PH: 614-481-4407
FAX: 614-481-5463

The Ohio State University Bookstore
PH: 614-292-2991
FAX: 614-292-8983

Dayton, OH
Books & Co.
PH: 513-297-6358
800-777-4881
FAX: 513-298-7895

Wilkie's
PH: 513-223-2541

Wilkie's South
PH: 513-434-8821

Fairborn, OH
Wilkie's
PH: 513-429-1677

Wright State University Bookstore
PH: 513-873-2875

Holland, OH
Little Professor Bookstore
PH: 419-865-0013

Kent, OH
Kent State Univ. Bookstore
PH: 216-672-2762

Mayfield Heights, OH
Micro Center
PH: 216-449-7009
FAX: 216-449-7008

Rocky River, OH
Booksellers
PH: 216-333-7828

Sharonville, OH
Micro Center
PH: 513-782-8509
FAX: 513-782-8508

Toledo, OH
Leo's Bookstore
PH: 419-255-5506

OREGON

Beaverton, OR
Powell's Bookstore
PH: 503-643-3131

Portland, OR
Powell's Technical Books
PH: 503-222-3906

PENNSYLVANIA

Altoona, PA
The Bookstore, Inc.
PH: 814-943-1984

Burnham, PA
The Bookstore, Inc.
PH: 717-248-2000

Chambersburg, PA
README.DOC
PH: 800-678-1473
FAX: 717-264-8614

Everette, PA
The Bookstore, Inc.
PH: 814-623-2000

King of Prussia, PA
Gene's Books
PH: 215-265-6210

Huntingdon, PA
The Bookstore, Inc.
PH: 814-643-0924

Philadelphia, PA
Drexel University Bookstore
PH: 215-895-2861

How-To-Do-It Bookshop
PH: 215-563-1516

Quantum Books
PH: 215-222-0611
FAX: 215-222-3148

University of Pennsylvania Bookstore
PH: 215-898-7520

Pittsburgh, PA
Univ. of Pittsburgh Bookstore
PH: 412-648-1453

West Chester, PA
Chester County Book Co.
PH: 215-696-1661

RHODE ISLAND

Providence, RI
Brown University Bookstore
PH: 401-863-3168

SOUTH CAROLINA

Columbia, SC
South Carolina Book Store, Inc.
PH: 803-799-7188
FAX: 803-799-5521

TENNESSEE

Knoxville, TN
Campus Bookstore
PH: 615-525-7336

University Book & Supply Store
PH: 615-974-3361

Nashville, TN
Tower Books
PH: 615-327-8085

VIRGINIA

Blacksburg, VA
Virginia Tech Campus Bookstore
PH: 703-231-5991
FAX: 703-231-7786

Richmond, VA
Book Gallery
PH: 804-673-9613

WASHINGTON

Bellevue, WA
Tower Books
PH: 206-451-1110

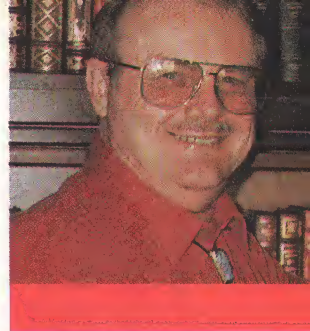
University Bookstore
PH: 206-646-3300

Seattle, WA
Tower Books
PH: 206-283-6333

University Bookstore
PH: 206-634-3400

WISCONSIN

Milwaukee, WI
Harry W. Schwartz Bookshop
PH: 800-236-7323
FAX: 414-274-6408



JERRY
POURNELLE

PONDERING OS/2

I wonder if the people who mind our business for us think things through. That is: I'm making popcorn in the small microwave I just bought for my upstairs office. The microwave is perched precariously on a stack of cables, because the cord is too short to reach the wall socket from the sturdy bench I put in to hold the microwave. Tomorrow I'll get an extension, which of course will make the cord longer than it would have been if they'd made it a reasonable length in the first place.

Our cappuccino machine has the same problem: this very hot metal object has to be moved close to the edge of the counter if we want to plug it in. Meanwhile, my lawn mower has an enormous sticker that warns me not to put my feet under it when it's running; I wonder how many people (1) can read, (2) don't already know that putting your hands and feet under a running lawn mower isn't too bright, and (3) having read that warning will see the light. I suppose next some genius will make us put labels on our cats warning us not to carry them by the tail.

OS/2 at Last

We've installed OS/2. I wanted it to be a fair test, so we put it on the Gateway 2000 486/50, easily the fastest computer in the house just now. When we began the OS/2 setup, the Gateway had 8 MB of RAM, a Sound Blaster Pro card, and a Corel SCSI card supporting a Toshiba CD-ROM drive running off Corel software. The video card is a special edition of ATI Technologies' Graphics Ultra (with no mouse port) that comes with the Gateway. The ATI card is a good one for OS/2 because it has 8514/A emulation, and IBM software is fond of that.

The Gateway computer is a beautiful little machine, and I have no hesitation in recommending it. It comes with a good monitor, but I've been running it with a better one: NEC Technologies' MultiSync 4FG, which is an awfully good monitor for its price. One caution: if you're going to use the 4FG where there's glare, such as a bright window, you'll want the optional filter screen that slides into slots on the 4FG's case. That works wonders on glare and doesn't detract from the color and screen brightness. Unless you'll always be using the 4FG in an interior room, I'd recommend getting the filter.

On the other hand, the Nanao Flexscan F550i works wonderfully in any room under any light conditions. Of course, it costs more than the 4FG. The monitor that Gateway ships with their computer is good enough, but I recommend that serious users buy it without a monitor

and get one from NEC or Nanao. The difference will be worth the price.

Prior to installing OS/2, we had the Gateway running Windows 3.1 and Norton Desktop for Windows under Quarterdeck's QEMM memory manager. The CD-ROM was available as drive D in both Windows and DOS. One CD-ROM program we had running was Sherlock Holmes, a game that has quite a bit of motion video with Sound Blaster Pro music and speech. It's a very impressive multimedia display and a rigorous test of the system, if a bit limited as a game (not enough cases).

OS/2 installs from 18 primary disks and half a dozen disks holding specialty printer drivers and the like. The installation takes about an hour if everything goes right. If things don't go right, it can take considerably longer.

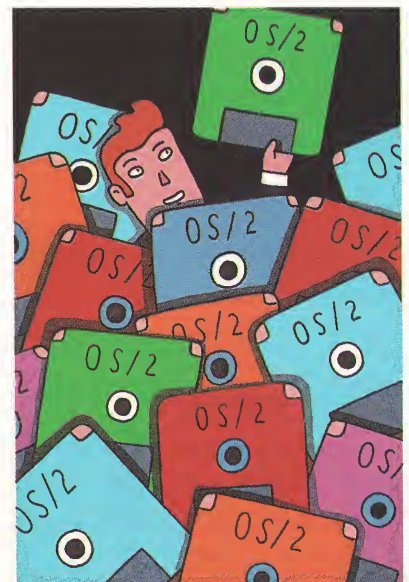
Preparing for OS/2

First, you can leave in the Sound Blaster Pro card, but take out your SCSI card. Don't just disconnect the SCSI devices; take the card out entirely. Our first installation of OS/2 failed because we had that card in there.

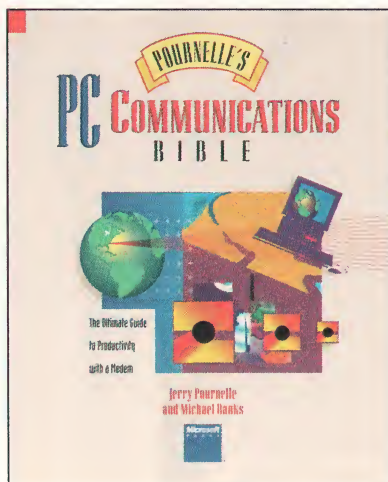
Second, if you have Windows 3.1, remove it. If you have Windows 3.0, you can leave that installed. If you don't get rid of 3.1, you can get some screwy results when you start trying to run Windows applications in OS/2. Moreover, most of the Windows 3.1 applets, such as card file and calendar, won't work anyway. If you try to run them, you'll get a long delay, a screen of trademark information about as useful as a "no handle" tag on a cat's tail, and finally a message that this Windows session can't run that application. Better not to have them around in the first place.

Third, be sure you have 8 MB of RAM. I'm told that OS/2 will work with 6 MB, but people I trust say 8 MB is pretty much a practical minimum. Running OS/2 with

OS/2 2.0 gets a real workout—and receives high marks—at Chaos Manor



Modem Power



- A buyer's guide to modems and the latest communications software—choose the features you really need!
- A directory of online services—get the information you want fast!
- Troubleshooting tips—save time and money when problems crop up!

Pournelle's PC Communications Bible

Wherever books and software are sold. \$27.95

Microsoft Press

To order direct, call

1-800-MSPRESS

Refer to ad ABY

Microsoft Press, One Microsoft Way,
Redmond, WA 98052-6399

In Canada,
Macmillan Canada. 416-293-8141

USER'S COLUMN

4 MB is painful: the system will be accessing the disk a *lot*, and you'll wonder why you ever bothered.

I can't emphasize that enough. OS/2 is a robust operating system with a number of desirable features—we may even adopt it here at Chaos Manor if they get more peripheral drivers written and Windows 3.1 support as promised; but you *must* have proper hardware. That doesn't mean you need a superfast 486. A good 386/25 will run OS/2 nicely, *provided* you have a large hard drive, 8 MB of RAM, and a good, fast video card. Note that Windows needs a large hard drive and a fast video card, too, but it will run in 4 MB. I don't recommend either Windows or OS/2 unless you have the right hardware for the job.

Given the right hardware, OS/2 instal-

utes, as OS/2 decompresses some files and begins to tidy things up. If you interrupt that process, you'll have to start the installation all over again.

Now What?

When you install Windows, the Setup program searches through your disk, looking for both Windows and DOS applications. If it finds any, it makes icons for them. In theory OS/2 does the same, but the only DOS program it found for me was Norton Utilities. Norton Commander, Procomm Plus, various text editors, and a number of games were ignored. I found I had to do most of that installation myself; and when I did, I got it very wrong. I tried it without reading the manuals. I don't advise doing that. Read your OS/2 manuals or a good third-party book on OS/2. It will save you time in the long run.

Understand, unlike Windows, which is a program that runs under DOS, OS/2 2.0 is a relatively *new* operating system. It is *not* a DOS program, nor is it merely "super DOS." It really is different, and it has its own philosophy that will have to be learned. That philosophy is self-consistent and has many features I wish had been incorporated into Windows; but it must be learned, and that is going to take some time and effort.

Installing DOS Programs

There's no Program Manager in OS/2. Instead, there's a folder full of "prompts." Open it by double-clicking. One of those is a full OS/2 window; another is a full-screen DOS prompt. There's also a windowed DOS prompt that—unsurprisingly—brings up DOS in a small window. Either of the windows that you get by double-clicking on one of the DOS prompts will work to let you run your DOS software's installation program or to copy the software from a floppy disk to the hard disk.

There's also a folder marked Drives, which has an icon for each drive and sort of functions the way the Windows File Manager works. That will also let you copy programs from floppy disks or run installation programs.

I didn't like any of these, so the first thing I did was to install Norton Commander. I use Commander in Windows, for that matter. It works just fine in Windows or OS/2, but, alas, I installed it incorrectly.

The proper way to do it (given that Commander was already on the hard disk, so I merely needed to tell OS/2 to create an icon for it) would be to open yet another folder, called Templates, and select the icon called Program. Use the right-

There's no
Program Manager
in OS/2. Instead,
there's a folder full
of "prompts."

lation is relatively simple, if tedious. There aren't too many questions, and the booklets furnished with the program give explanations.

You are asked two key questions. The first asks if you want the OS/2 advanced file system. Say "no." Otherwise, you will have to reformat your hard drive, and you will be unable to go back to DOS/Windows. There are enough problems with OS/2 that you will feel a lot better if you can easily retreat to DOS; and that's simple provided you don't go to the advanced file system. Stick with the simple one.

The second key question is resolution. High resolution is greatly to be preferred if your video card and monitor can handle it. Otherwise, you can use OS/2 in regular VGA, but that desktop gets pretty busy even in high resolution. Of course, this is all true of Windows as well.

After you've fed the system a few disks, the installation program begins multitasking and offers you a tutorial. If you have nothing better to do, you may as well let it teach you some fundamentals; you won't be using the machine for another few min-

16.7 Million Colors



Count them...a full 16.7 million colors!

It's the ultimate in video display technology from Genoa Systems. The Multimedia VGA 7900 allows you to view dazzling images on the screen with a depth and richness comparable to a photograph. An additional feature is Safescan™, which provides full edge-to-edge viewing without any bothersome black border.

Offering super VGA compatibility, the full 16.7 million colors can be displayed in Windows 3.1™. Autosshade® or any other program capable of displaying 24-bit "true color". And it boasts of flicker-free performance with 72Hz refresh rate, which meets all VESA standards.



The Genoa 7900 video card also displays up to 64 thousand colors at 800 x 600, 256 colors at 1,024 x 768 and 16 colors at 1,280 x 1,024. The Multimedia VGA is an ideal solution for Big Screen viewing!

Plus Genoa is offering a FREE 24-bit Tempra GIF and Show, an advanced multimedia software, with every 7900 VGA board. This offer is available for a limited time only.

Another winning graphics product from Genoa!
The price is right, too.



The Ultimate Graphics Solution



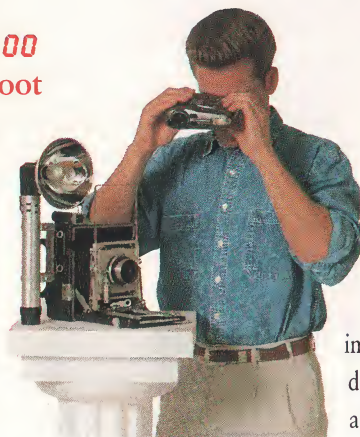
For the name of your closest dealer, call: (800) 531-3969 or (800) 93-GENOA

Genoa Systems Corporation 75 East Trimble Road San Jose, CA 95131, Tel. (408) 432-9123
Tech support: (408) 432-TECH, Fax: (408) 434-0997, Genoa BBS 1: (408) 943-1231, Genoa BBS2: (408) 943-1256
All products and brand names are trademarks of their respective companies.

Circle 516 on Inquiry Card (RESELLERS: 517).

Join the New Imaging Revolution

**10:00
Shoot**



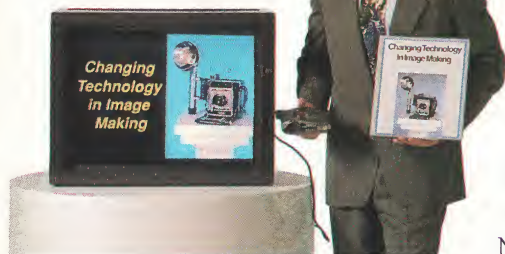
The new *Canon RC-570 Still Video Camera* records 25 electronic photos on a reusable 2-inch video floppy disk. No film or processing. No waiting. No waste. The 3X zoom lens and 450-line frame video resolution ensure superior image quality. Speed, portability, ease of use, and direct playback to a TV monitor make the RC-570 an ideal imaging tool.

**10:12
Process**

Canon digitizers allow still video images to be easily input to Macintosh®, PC, or NeXT™ computers. Integrate graphic files into applications like DTP, Databases, Multimedia and Presentations. You can even record from your computer back to video floppy with our *Electronic Still Presentation* systems.



**10:45
Present**



Use the RC-570 still video camera connected to a TV monitor to deliver impressive computer generated presentations directly from your video floppy disk. No computers. No slides. No projectors. No hassles. *That's Revolutionary!*

Learn more about this revolution, call 1-800-221-3333 ext. 313.

Please see us at

COMDEX/Fall '92

Booth 1658

Canon



© 1992 Canon USA, Inc. Still Video System Division, One Canon Plaza, Lake Success, NY 11042
Brand and Product names are trademarks of their respective holders.

USER'S COLUMN

hand mouse button—OS/2 uses the right-hand mouse button a *lot*—to drag that template out onto the desktop. This creates a copy of the template icon; the old template is still back in the Templates folder. Right-click on the copy, and a little notebook shows up; use that to name the program, specify the path, name the Icon, set a start-up directory, and so forth.

There are other pages to this "book," and in them you can tell OS/2 how much expanded memory to allocate, play about with video-system options, and do a bunch

The WIN-OS/2

**Full Screen icon
launches a bare-
bones instance of
Windows: no applets,
no wallpaper, and
no File Manager.**

of other optimization stuff. Learning what to do with that is not easy. It's not well documented in the manuals, and the help files are from that peculiar school that teaches how to write text that is clear and informative only to people who already knew the information in the first place.

The best way to learn many of the features of OS/2 is from an OS/2 enthusiast. You can find them on BIX, GENie, and other electronic information services; I strongly advise anyone trying to learn OS/2 to get on one of those services. An awful lot of essential knowledge about OS/2 is passed along only as folklore. That's also true of Windows and the Amiga. All powerful systems seem to have lots of badly documented, or undocumented, features.

Fortunately, for most DOS programs you will install on OS/2, the default settings will work just fine; you won't need to do any fine-tuning to get started, and later on you can learn the tips and tricks needed to optimize. The fact is, just about all DOS programs run better under OS/2 with the default setup than they do under Windows optimized or, for that matter, under DOS itself.

When you finish telling OS/2 about your

MINUTEMAN PLUGS IN WORLDWIDE.

Now get total power protection from MINUTEMAN anywhere in the world. MINUTEMAN takes charge worldwide with instant protection when you need it most.

Every day your company relies on its voice and data communications equipment to stay productive. Unfortunately, the electricity that powers these vital systems is not reliable.

Blackouts, brownouts, spikes, surges and even lightning strikes are common. And the high cost of losing vital information and productivity due to power outages and



MINUTEMAN PRODUCTS

- On-line and standby UPS
- Shutdown software for every available operating system
- 300VA to 10KVA
- TUV approval
- Now in over 100 countries
- Regional service centers
- Automatic voltage regulators
- All international voltages

surges calls for preventive measures.

But power requirements can be confusing. And your company has unique needs that often require custom solutions.

MINUTEMAN offers the most comprehensive line

of UPS systems available, protecting all your business equipment from stand-alone workstations to the largest of the IBM AS/400s.

MINUTEMAN products are sold and serviced worldwide. Call on our skilled professionals to help you determine your exact power protection needs.

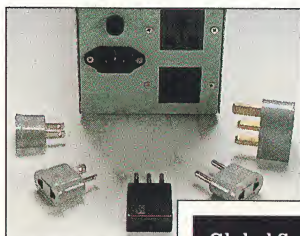
Contact our Power Professionals on the POWER FAXLINE below, or call (214) 446-7363 for your free Power Protection Guide.

(214) 446-9011 Fax

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES

**Reduced prices
up to 36%**

Call for complete price list.



Our MINUTEMAN Global Socket (GS) Series uninterruptible power supplies accommodate the unique needs of our international customers. You no longer need to use adaptors or cut and splice on a new plug. Our GS UPS systems are universal and compatible with all major

plug patterns.

Our UPS systems are ready for both the individual computer and for your network. These popular MINUTEMAN UPS systems

Global Socket UPS systems are universal and compatible with these plug patterns.

- British (standard)
- European (Europlug)
- Australian
- Italian
- French

employ our advanced technology to create the most dependable UPS available.

By integrating the latest MOSFET technology requiring fewer components, each GS Series

model is more compact.

The result is a truly advanced and economical UPS for all your business needs, worldwide.

FOR LAN
NOVELL
TESTED AND
APPROVED
TESTED



Circle 164 on Inquiry Card.



new program, drag the icon to whatever group folder you like and drop it in. You can also create new empty group folders.

However, if you right-click on the Program icon *while it is still in the Templates folder*, the little notebook pops right up; and if you then give it a program name and path—I gave it the specs for Norton Commander—you're doomed. Thereafter, when you drag that icon out to the desktop, it starts the program you entered. You cannot install any other DOS programs. I had

about 10 copies of Commander going before I got wise. The remedy is to go back to that Program icon in the Templates folder, right-click, and erase everything so that all the program specs are blank again. Enter program specs only on a copy of the program folder that you've dragged out onto the desktop.

There are several other gotchas, and as I said, the help files were largely written by people from the "clear only if previously known" school. Eventually, though, you

will get your DOS programs installed and organized.

Alas, they will all have the same boring icons. OS/2 comes with an icon editor, which lets you draw your own icons; but OS/2 does *not* recognize icons done for DOS programs, and the OS/2 icon editor will not read those third-party icons. The good news is that there's a freeware program that will convert Windows icons to OS/2 format, so you can have the Commander's hat and gloves, or Civilization's city and pharaoh, if you take the trouble to download it from BIX or GENie. What I really wish is that IBM would add the ability to read Windows icons into the OS/2 icon editor. Then they could be saved, modified or not, in OS/2 format.

Running DOS in OS/2

DOS programs run just *great* in OS/2. The memory management is invisible and nifty: extended memory, expanded memory, virtual memory up to 32 MB per program,

OS/2's learning curve is steep and long. A better DOS than DOS, yes. A better Windows than Windows, no.

Picture this...

NEW

FEATURES

- ▶ Full VT340/420 Terminal emulation
- ▶ ReGIS, Tektronix & sixel graphics
- ▶ Multi-sessions
- ▶ Multilingual menus
- ▶ Copy & paste
- ▶ DDE
- ▶ File transfer
- ▶ Network interfaces
- ▶ Script language
- ▶ On-screen buttons

VT340 GRAPHICS for WINDOWS

WE'VE JUST ADDED A NEW DIMENSION TO VT340 FUNCTIONS—WINDOWS.

KEAterm 340 gives the power of Windows to your host applications.

KEAterm products combine the features of Windows with the features of a VT terminal for true PC-to-host integration. Control your host data just as you control PC applications—with access to the same powerful software and printers. Host data becomes truly useable.

With KEAterm 340, you can use PC graphics tools to expand the use of host graphics. Copy ReGIS, Tektronix and sixel images into desktop publishing or draw packages for further manipulation.

Picture new power for host applications with KEAterm 340 for Windows.

Preview KEAterm 340 for Windows at Interop, 26-30 October in San Francisco, Booth #5502



KEA Systems Ltd.
Call 1-800-663-8702
Phone: (604) 431-0727
Fax: (604) 431-0818

KEA Systems Ltd. 3738 North Fraser Way, Unit 101, Burnaby, BC, Canada V5J 5G1
 KEAterm, KEAterm 340, PowerStation, KEA and their respective logos are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.
 Copyright © KEA SYSTEMS LTD. 1992. All rights reserved.

no problem. I have not yet tested programs that run the Phar Lap memory extensions, but I'm told that they will work all right. I have run word processors, including Microsoft Word; Norton Commander, including Commander Mail; communications programs; and some really complicated games, including Wing Commander. I've run several copies of Wing Commander at once. It gets slow and jerky—hardly astonishing—but they all do work.

You'll have to muck about doing some fine-tuning. OS/2 substitutes its own AUTOEXEC.BAT for yours; and the Path, Prompt, and various Set Environment statements telling your system how to find, say, Grammatik V or the Sound Blaster Pro card, may be gone. You may not notice that at first. Wing Commander, for instance, has a setup routine that tells it what

EISA SCSI Caching

How do you move volumes of data from your SCSI device fast and efficiently? With the Fast Disk EISA SCSI Caching Host Adapter from American Megatrends.

THE SUPERIOR PERFORMANCE SOLUTION

The Fast Disk SCSI controller supplies the industry's highest transfer rates and uses a 386SX CPU to manage up to 16MB of cache.

"...superlative disk performance - the best seen by PC Labs thus far - thanks to AMI's Fast Disk Controller, a 32-bit SCSI EISA card with a 386SX/16 microprocessor and 16MB cache." *PC Magazine - June 16, 1992*

UNBEATABLE COMPATIBILITY

The Fast Disk SCSI Host Adapter is compatible with the popular Adaptec 154X and BusLogic drivers, and supports a wide assortment of SCSI devices, including hard drive, tape, CD-ROM and WORM.

FROM THE LEADING EISA DEVELOPERS

As the leading developer of EISA motherboards and EISA BIOS, American Megatrends has the knowledge and resources to support your EISA applications. With over 150 combined years of EISA/SCSI design experience and the only company with both board and BIOS design knowledge, you are ensured compatible designs that work.

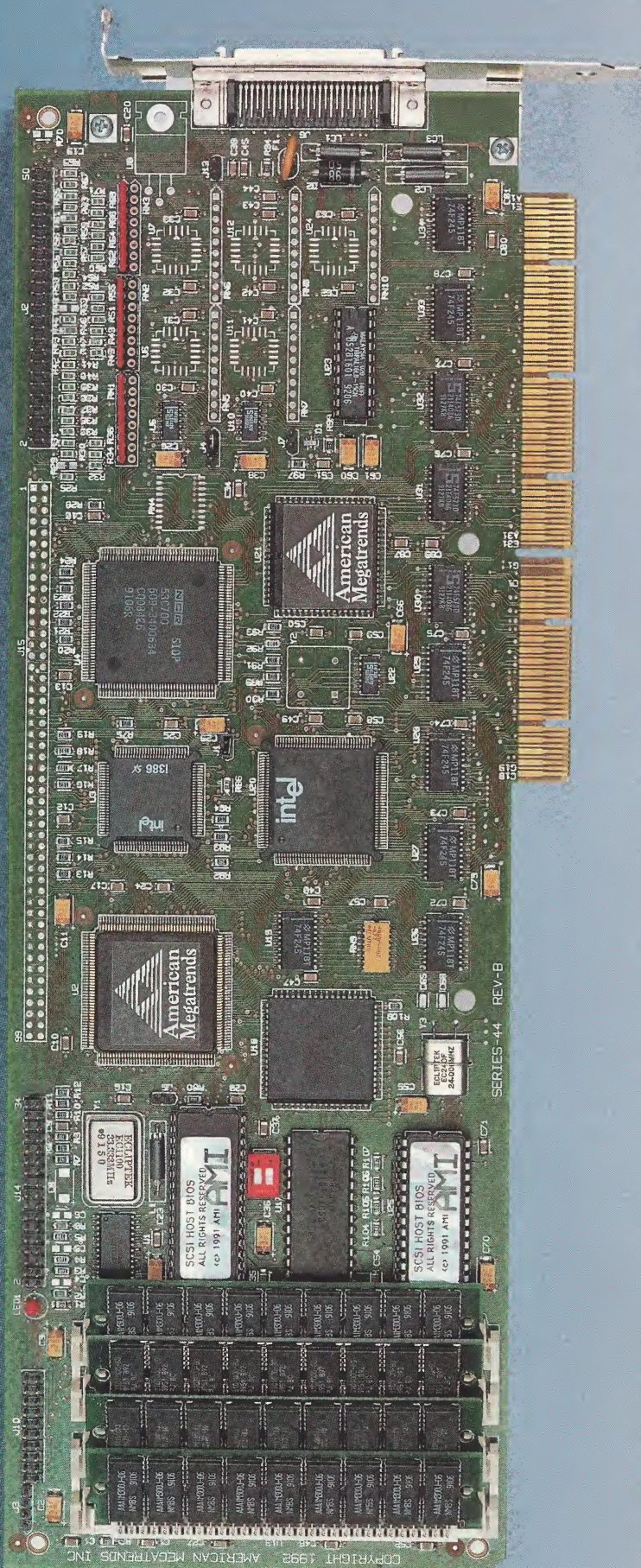
For full information on America's premium EISA peripheral cards, call American Megatrends today and see why more people move more data with AMI.

AMERICAN MEGATRENDS, INC.
6145-F NORTHBELT PARKWAY
NORCROSS, GA 30071
(404) 263-8181, FAX (404) 263-9381
(800) 828-9264, (800) U-BUY-AMI
IN SINGAPORE (65) 294-6714
IN THE U.K. (0293) 536-365



American
Megatrends

Distributed by **MERISEL** (800) MERISEL



BEFORE PROTECTING YOUR SOFTWARE...

SEE US AT
COMDEX/Fall '92
Booth # 5886

...against piracy and unauthorized use, make sure that your protection system has all the following qualities:

A GOOD HARDWARE KEY

Hardware-based software protection systems are now the standard worldwide. However, not all keys are the same. A good key should have all the following features:

✓ Compatibility and transparency. The key should work without any problem on your customers' computers. The user should be able to forget the key after connecting it.



✓ Unbreakable electronics. A customized ASIC (Application Specific Integrated Circuit) component should be integrated in the key. This prevents reverse engineering and makes cracking virtually impossible.

✓ A unique and inaccessible software developer's code burnt into the ASIC. (This code should not be held in the key's memory, where it can be read and altered.)

✓ A Read/Write Memory inside the key should be available on demand. The memory should be writable in the field, on any PC, without any special programming equipment.

✓ Very low power consumption, enabling the key to work even under the worst power conditions, on PCs and laptops, with or without a printer.

POWERFUL SOFTWARE

Since it's practically impossible to crack or duplicate a key having all the features mentioned above, a pirate will usually go for the software linking the protected program to the key. Therefore, check that your protection software has all of the following:

✓ A Linkable Protection Module with which calls can be made to the key from any point in the protected program.



✓ An "Envelope" installation program. Such programs enhance security while making it possible to protect a software even without its source code.

✓ Sophisticated antidebugging and encryption mechanisms.

HASP®, THE PROFESSIONAL SOFTWARE PROTECTION SYSTEM, OFFERS YOU ALL THESE FEATURES AND MORE:

HASP was designed by a team of computer experts, professional cryptologists, and electrical engineers. As a result, HASP keys are supported by what is probably the best software in the market, and the HASP system has worked on every computer it has been tried on. In addition to all the features mentioned above, HASP provides:

✓ A Full Authorization System for protecting dozens of programs using only one key.

✓ A Pattern Code Security System (PCS) enabling parallel processing of multiple calls by the Linkable Protection Module.

✓ A Virus Detection option that can be incorporated in the protected program to check whether it has been infected by a virus or tampered with in any way.

✓ Several HASP keys can be daisy-chained.



NETHASP, SOFTWARE PROTECTION FOR NETWORKS

✓ Only **one** NetHASP key is needed to run a protected program from many stations in a network. NetHASP provides full support for protecting DOS and WINDOWS software under network environments, including Novell dedicated & non-dedicated servers, Lan Manager, Lantastic, Banyan, DLink, and NET-BIOS based LANs.

IN A TEST CARRIED OUT BY AN INDEPENDENT LAB, HASP WAS THE ONLY KEY WHICH WAS NOT BROKEN*.

OPERATING ENVIRONMENTS

- ✓ **PC:** DOS, WINDOWS, OS/2, SCO UNIX, SCO XENIX, AIX, AUTOCAD, DOS EXTENDERS
- ✓ **MAC (ADB Port):** System 6.0.5 and up
- ✓ **NEC (Serial Port):** DOS, WINDOWS

AND THE BOTTOM LINE:

We offer some of the most competitive prices in the market.

Since 1984, HASP has enabled thousands of software producers in more than 40 countries, including several Fortune 500 companies, to protect their software.

To learn more about why so many professionals have chosen HASP, please contact:



15 Beit Oved St., Tel-Aviv, Israel
P.O.Box:11141 Tel-Aviv 61110
Tel: 972-3-5375795
Fax: 972-3-5375796

In North America:

ALADDIN SOFTWARE SECURITY

200 Broadhollow Rd., Suite #207
Melville, NY 11747, USA
☎ 800-223 4277, 516-424 5100
Fax: 516-424 8300

- Australia Conlab Pty. Ltd., Tel: 3 8985685
- Belgium Akkermans bvba, Tel: 3 2338826
- CSFR ATLAS Ltd., Tel+Fax: 2 766085
- Chile Micrologica S.A., Tel: 562 222 1388
- Denmark SC Metric a/s, Tel: 42 804200
- France Logidata Intl., Tel: 50707375
- Germany CSS GmbH, Tel: 0201 74 986-0
- Greece Unibrain SA, Tel: 1 6856320
- Holland Akkermans BV, Tel: 45 241444
- Italy Partner Data S.r.l., Tel: 2 33101709
- Korea Dae-A Engineering Co., Tel: 2 848 4481
- New Zealand Training Solutions, Tel: 4 5666014
- Poland Systherm Tel: 061 45065
- Portugal Futurmatica Lda., Tel: 1 4116269
- South Africa D Le Roux, Tel: 11 886 4704
- Spain PC Hardware, Tel: 3 4493193
- Switzerland Opag AG, Tel: 61 7112245
- Taiwan Tecco Ltd., Tel: 02 555 9676
- Turkey Mikrobeta Ltd., Tel: 4-4677504

* CT Magazine, May 1990.

© Aladdin Knowledge Systems Ltd. 1985-1992

kind of video and sound card you have; and it will go find the Sound Blaster Pro, and out will come the music.

On the other hand, Warlords, as an example, tries to find your sound card. If you have the proper environment settings, it will be able to under DOS or OS/2 (but almost never under Windows; I don't know why). If you don't have the right settings, it won't find the card and there will be no sound. In other words, when it comes to sound cards, OS/2 sometimes works the way Windows does: it requires evil and potent magic to enable the sound.

Windows Under OS/2

There are two ways to run Windows applications under OS/2. One is to open the folder called Windows Programs, find your program in there, and open it. The system will trundle for a while and then display some stupid trademark notices. If you had a bunch of Windows 3.1 applications on your hard disk, this is probably one of them and you'll get a message that the applications can't be run. Considerable time is wasted to no purpose.

If it does work that way, it will be slow. I mean *really* slow, and it won't matter much whether you have other processes going at the same time. It's just going to be slow. Video objects will drag across the screen—this on a 486/50 with a fast video card. It's worse on slower hardware.

The other way to run Windows applications under OS/2 is to open the WIN-OS/2 Full Screen icon. That will bring up an instance of Windows.

It's not a complete Windows. There are no applets and no wallpaper. (The applets are back on the OS/2 desktop; press Alt-Escape to change to that and run the OS/2 calendar and clock. There's no card file.)

There aren't any programs located and grouped as applications the way Windows does when installed. You'll have to figure out where your Windows programs are and install them one by one, building up your Windows desktop from scratch. Since there is no possibility of running a DOS window, you cannot save your new setup unless you exit WIN-OS/2, having checked the Save Setup box. Warning: if you merely close the WIN-OS/2 window from the OS/2 desktop, all the arrangement work you have done will be lost.

There is no File Manager; you're on your own in finding your Windows applications and their paths. If it will show you a directory tree, I wasn't able to find it. You can pop back to OS/2 and use the disk drives' "object," but that's a bit of a pain. I tend to use Norton Commander, but that too requires changing from the WIN-OS/2 window to a DOS application Window

that wasn't on your WIN-OS/2 desktop. A better solution is to run Norton Desktop for Windows. That works. It has its own file manager and some of its own applets and utilities, and it lets you save your configuration without exiting the window.

WIN-OS/2 does recognize your familiar Windows icons, so you can build your desktop with those.

Within this WIN-OS/2 window, your applications will run faster than they do if opened one at a time directly from the OS/2 desktop; but they will be considerably slower than if you were running Windows 3.1 under DOS. So it goes.

Conclusion: it's not a better Windows than Windows. At least not yet.

Tricks and Limits

If there are any OS/2 CD-ROM drivers, I can't find them. I have some Corel drivers that purport to work with OS/2 but don't. Corel says they have CD-ROM working with OS/2, but no one else I have talked to knows how to do that.

Nor will drivers run in WIN-OS/2. Moreover, this limitation applies to all SCSI devices: tape drives, WORM drives, optical disks; as I write this, none work in

OS/2 windows. A number of outfits are said to be writing OS/2 SCSI drivers—given Corel's usual success in systems integration, it's surprising theirs don't work yet—and by the time you read this, there should be good SCSI OS/2 drivers, so ask around.

There is a way to create a window in which you can run CD-ROM drives. It's called *double booting*, and it's an interesting trick.

What you must do is dump OS/2 and turn your machine back into a DOS system. This is surprisingly easy to do. An OS/2 command in the Prompts folder does it simply and painlessly. The system exits OS/2 and reboots itself as DOS (and will boot as DOS from then on until you enter the OS/2 subdirectory and issue the command BOOT /OS2, which will convert it back).

Once you are running DOS, format a floppy disk with the /s (i.e., system) option to make a bootable disk. Now transfer your old CONFIG.SYS and AUTOEXEC.BAT to that floppy disk and edit them so that they have all the drivers and commands (e.g., MSCDEX) required to access your CD-ROM. Keep that disk, open

We didn't
start the PC
price war.

(We'd never back down
on quality.)

the A drive door, and do the `BOOT /OS2` command. Your system will trundle for a while and come up in OS/2. Since OS/2 remembers everything you were doing when you shut down, you will first have to say "no" to the question "Do you want to exit OS/2 and reboot in DOS?"

Now open the Prompts folder, and you will see a Boot from A option. Put your new system disk in the A drive and click away. OS/2 will create a window containing a virtual machine with that floppy disk's `CONFIG.SYS` and `AUTOEXEC.BAT`. If you've done everything right, you *may* be able to use your CD-ROM.

I say *may* because I never did get the Corel CD-ROM system to work. We did get the slower CD-ROM drive that plays off the Sound Blaster Pro card to work. I am told that Future Domain SCSI boards can be made to work, but I don't know. Telephone calls to OS/2-using friends like Rich Heimlich get the information that they can use CD-ROM in one of those floppy-disk-booted windows under OS/2, but they do it only because they have to. They think this is a kludge and advise waiting for the OS/2 CD-ROM and other SCSI device-driver software. Everyone is sure

that the drivers will be out by the time you read this. I sure hope so.

Incidentally, you can boot up a window running *any* bootable DOS-type operating system with that boot-from-floppy-disk trick. You can bring up DOS 3.3 or DR DOS 6.0. The one thing you cannot do is run QEMM in there. Being a memory manager, it conflicts with OS/2. On the other hand, you can run `HIMEM.SYS` and some of the Microsoft DOS memory manager stuff. The boot-from-floppy-disk deal is a neat trick; some may find it useful.

Bottom Line on OS/2

I've used more space on OS/2 than I intended. My conclusion is that if you run mostly DOS programs and you don't need a CD-ROM drive right away, OS/2 has a lot of advantages. It's fast, installation of DOS programs is harder to describe than to do, and memory management is smooth and effortless. DOS programs run just fine full-screen or windowed, and transfer of stuff between DOS windows under OS/2 is easier than doing those transfers in Windows.

If you want to run mostly Windows programs, get Windows 3.1. That will run

DOS programs well enough and Windows programs far better than OS/2 will. That may change with new versions of OS/2, but right now it is not a better Windows than Windows. If you do get OS/2, Norton Desktop for Windows will make `WIN-OS/2` considerably more convenient.

If you want to play with OS/2 and you can't live without CD-ROM and multimedia, it's all right to install OS/2 and begin getting used to it, but wait until you know those peripherals operate in OS/2 before making the change permanent.

The learning curve is steep and long. A better DOS than DOS, yes. A better Windows than Windows, no.

A Windows Problem

You can tell a Windows aficionado by the big monitor running at high resolution—1024 or 1280—and the cluttered desktop. However, if you run Windows at high resolutions, you have a problem: Windows games generally won't run full-screen. It's odd. DOS applications run full-screen: the resolution changes to accommodate. Windows applications can't do that. Solitaire, for example: on a high-resolution screen, the cards are tiny.

The result is that many games applications are not written for Windows at all because Windows can't scale from regular VGA when it encounters high resolution. Maybe this will be fixed in Windows NT.

Near Disaster

I was talking on the telephone. Windows was up and running. I'd be stuck on the phone for a while, so it seemed a good time to send Commander Mail out to collect my MCI Mail. The only problem was that I had the phone resting on my shoulder, and I needed my right hand to take notes. I couldn't reach the mouse with my left hand.

I remembered there is a way to control Windows from the keyboard. I tried `Alt-W`. That would actually have worked, had I then used the arrow keys to highlight the list of window names, but I was distracted by the phone and pressed `Return`. That rearranges your desktop windows to cascade format, which means that all the windows are the same size and arranged one behind the other. I think it's a lousy way to organize your desktop.

There isn't much you can do to get rid of that cascade arrangement and go back to what you started with. You can individually resize each window and move it to where you want it, or you can turn the machine off. Nothing else will work. Unfortunately, I was still distracted by the phone, and I exited Windows. That did it: now Windows had saved that horrible cascade

We didn't start the PC price war.

(Price isn't everything.)

image as my normal desktop, and my carefully arranged desktop was gone.

At this point I must have taken leave of my senses. I was out of Windows, and it was going to take some work to restore my desktop; so for reasons I never will understand, I entered Palindrome's Network Archivist and told it to make a backup onto DAT (digital audiotape). It did, but now—now I had made a backup copy of that miserable excuse for a desktop arrangement. Absolutely stupid.

Fortunately, Network Archivist is smarter than I am. It keeps copies of old versions of files. By going into it and restoring PROGRAM.INI and all the .GRP files to one version previous to the current ones, in 10 minutes I had my desktop back. One more reason to cheer for Network Archivist; it's better than WORM drives. Incidentally, by the time you read this, Palindrome will have a new version that will copy to read/write optical disks. I like DAT: the medium holds a lot, and it's cheap—one-half cent per megabyte.

Intel Does It Again

Pournelle's Law states, "One user, at least one CPU." In fact, I believe in real multi-

processing: why time-share one CPU when you can have one CPU per task? Intel's Satisfaxtion system implements that philosophy.

This fax/modem board comes with its own CPU and half a megabyte of memory. That means it can truly run in the background. It can answer the phone, detect an incoming fax, and record that. Meanwhile, you are still working on whatever foreground tasks you've set yourself. You will not have heard the phone ring.

If there's another incoming call, the Satisfaxtion hears a voice request and rings the phone.

Later on you can give the Satisfaxtion a list of messages to send out by fax. You can specify a time for it to do that or have it start right in. All this works in DOS or Windows. I haven't been able to try it with OS/2 yet, and Intel didn't know if it would work.

The new Satisfaxtion 400E is a high-quality 14,400-bps modem with MNP, V.42bis, and all the trimmings, and it sells at a competitive price for such; but you also get the fax capability. Intel likes to say that the fax is free.

If that's not enough, if you get their soft-

ware package, you get an OCR (optical character recognition) program that really works. We sent ourselves a newspaper article from the regular fax machine to the Satisfaxtion. Then we aimed their OCR program at it: it read the whole newsprint article and put it into Word for Windows. There were only three mistakes.

I have been a fan of the Intel communications coprocessing system since they first came out with it. Now this product is better and cheaper than ever. Recommended.

Visual Basic and Crescent

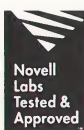
I've used up so much space and time on OS/2 that I won't be able to do a full report. Microsoft has Visual Basic for DOS. It's pretty much compatible with Microsoft QuickBasic and the BASIC compiler; the advantage is that it writes object-oriented code and makes creation of great user interfaces simplicity itself.

Best of all, it works with Crescent Software's library of BASIC tools, QuickPak Professional for Windows, including their communications library. You can do good BASIC programming without Crescent tools, including their PDQ library (link it

We didn't start the PC price war.

(This is where we draw the line.)

Now we the shot



486N Specifications • 32-bit Intel SX, DX and DX2 processors at 25, 33, 50 and 66 MHz. • 4 MB RAM, expandable to 48 MB • Local bus integrated Ultra VGA+ Video with graphics accelerators • 85-430 MB hard drive • 3.5" floppy drive • Three 16-bit expansion slots • ROM-based internal diagnostic and system guide • Integrated Flash BIOS and boot-ROM • Multilevel hardware security • Chip-upgradable

*Suggested U.S. list prices for HP 486/25N and HP 486/33N Model 1 PCs. †Press 1 for HP First, reference Document ID 6310, 6311, 6313. Microsoft is a U.S. registered trademark of Microsoft Corporation. Windows 3.1 is a product of Microsoft Corporation. The Intel Inside logo is a U.S. trademark of Intel Corporation. © 1992 Hewlett-Packard Company PPG-656

re calling S.



HP's new low-priced PCs don't surrender features.

Those cheap PCs don't stand a chance. Hewlett-Packard has introduced 486 models starting at under \$1,200*. With prices of our entire line of HP 486 and 386 PCs down as much as 42% in the last 9 months.

But our low prices have not come at the expense of quality, performance or the features you want.

To scream through those high-powered Microsoft® Windows and CAD projects, our revolutionary local-bus technology and fast graphics accelerators really fly. And, with

true multivendor compatibility, HP PCs fit easily into your computer environment.

We've also made big advances on the networking front. Many models come with preinstalled network interface cards and boot-ROMs. And, of course, HP PCs are fully tested and certified with all the major NOSes.

Our security features are so convenient people actually use them. And our 486 desktop PCs are chip-upgradable. So you can count on always having the latest and greatest.

All this for as little as \$1,200! And for a few hundred dollars more, we'll throw in a hard drive with pre-installed DOS 5.0, Windows 3.1 and a mouse.

To be a winner in the price wars, call **1-800-752-0900, Ext. 7094** for your nearest HP PC dealer. Or call 1-800-333-1917 from your fax handset for immediate details.† Then start calling the shots.



**HEWLETT
PACKARD**

instead of the standard BASIC library at compile time; it saves time and space). You can, but you're needlessly handicapping yourself.

If you do much BASIC programming, get Visual Basic for DOS; it will be a good transition path to Visual Basic for Windows and a painless way to learn about OOP (object-oriented programming). While you're at it, get QuickPak. Between them, you'll find you can write and debug astonishingly complex programs in a very

short time; they're the best programming productivity tools I know of.

Word for Word

I'll make this quick. Word for Word translates data files from one format to another, preserving as much information about formatting and fonts and suchlike as can be preserved. I use it. There's a new version of Word for Word. It has more formats, including Word for Windows, and some new spreadsheets as well as word proces-

sor formats. You can also use it to view files, even if you want to look at a file but don't have the particular word processor or spreadsheet that created the file. Recommended.

WinSleuth Gold 3.0

This is another product that deserves better than short shrift, but I'm out of room. This is about as complete a program for investigating your hardware and software as I know. It beats Quarterdeck's Manifest. It tells you all about everything, including which interrupts and ports are in use. You won't use this a lot, except when you have to install something new; then you'll want it bad. Recommended.

Procomm for Windows

I have used Procomm Plus for a long time. When I changed to Windows, I installed it with a PIF (program information file), giving it 2000 ticks in both foreground and background, and I've had no trouble with background downloads.

I was eager to get the Windows version. When I installed it, however, I found that the terminal window occupies only part of the screen, the default font is smaller and not as pretty as my DOS font, and it's actually harder to mouse around than it is to use commands and arrow keys. I used it a couple of times, and it works. There are some neat features here and there, but I find that Procomm Plus for DOS (running under Windows) works better.

Books About CD-ROMs

Meckler has been doing an amazing number of computer books on many subjects, but particularly CD-ROM books. I don't often see them in stores, which is a pity, because most of them are excellent. They tend to be specialized, the kind of thing that if you need them, you need them a lot: descriptions of databases, the massive *CD-ROMs in Print* (available as both a book and a CD-ROM version for \$95 each), and technical books on how optical drives work. They're uniformly good, and libraries in particular should be sure to get the Meckler catalogs (Meckler Corp., 11 Ferry Lane W, Westport, CT 06880, (203) 226-6967).

Winding Down

I've just seen the cover art for the book jacket to *The Gripping Hand* by Niven and Pournelle. It's gorgeous. The book's scheduled for February release.

The book of the month is Robert Leonhard's *The Art of Maneuver: Maneuver-Warfare Theory and Air Land Battle* (Presidio Press, 1992). It's a thoughtful and thought-provoking look at the modern U.S.

isobar® — THE BEST

SURGE SUPPRESSOR

JUST GOT BETTER!

BETTER FEATURES

We took Isobar®, the world's best surge suppressor, and gave it the **Ultra** enhancement. Now, in addition to premium AC surge and noise protection, the new **Isobar® Ultra** has:

DIAGNOSTIC CIRCUITRY

LEDs alert you of

- Improper outlet wiring
- Damage to protection circuitry
- Loss of AC power

INSTANTANEOUS RESPONSE

Suppresses spikes quicker to protect your equipment better.

ISOLATED FILTER BANKS

Eliminates interference between plugged-in equipment.



ISOLATED FILTER BANK 1

isobar®
Diagnostic Surge Suppressor

PROTECTION PRESENT LINE FAULT LINE PRESENT

isolated protection @ 1.0 MHz

first level (50 db)

UL 1449 (330 volt let-thru)
1283 (noise filtering)
497A (data-line protection)



MADE IN USA



ULTIMATE
Lifetime Insurance



70
YEARS OF
MANUFACTURING
EXCELLENCE

BETTER WARRANTY

Only **Isobar® Ultra** provides lifetime **Ultimate® Insurance** that covers any surge related equipment failures up to \$25,000 — including lightning strikes.

Isobars are available with 2, 4, 6 or 8 outlets, some with fax/modem protection. Call us today to see a sample.

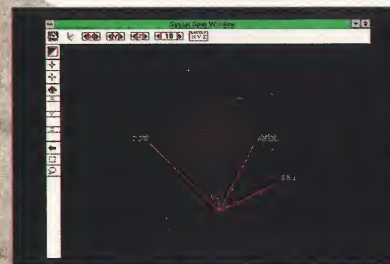


"THE POWER PEOPLE"

500 N. Orleans • Chicago, IL 60610
312/329-1777 • FAX: 312/644-6505
Call Today! Ask for Dept. F7.

NEW

SYSTAT® for WINDOWS

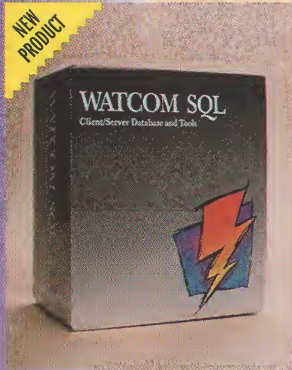


SYSTAT

© 1992 SYSTAT®, Inc. *Software Digest Ratings Report/2.5*, May, 1991. Software Digest is a registered trademark of NSTL, Inc.

One place stands alone in the programming scene...

NEW PRODUCT



WATCOM SQL Developer's Edition by WATCOM

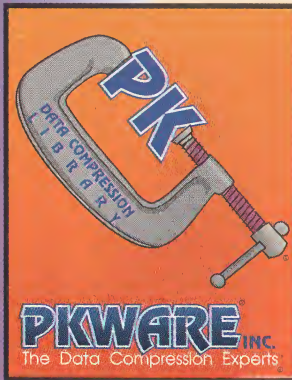
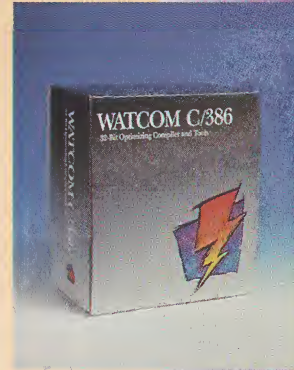
NEW PRODUCT-SPECIAL INTRODUCTORY OFFER. Complete client/server development tool allows you to develop and deploy single-user stand-alone applications, and to develop applications for use with the Network Server Edition. (sold separately). Includes: Single-user database server (both 16 and 32-bit versions); ACME application development system; Embedded SQL/C pre-processor; SQL libraries for WATCOM C, C/386, MS C/C++ and BC/C++.

LIST: \$395 **PS Price: \$379**
FastFacts 1044-035

WATCOM C/386 by WATCOM

Develop and debug 32-bit applications for extended DOS, Windows and OS/2 2.0. Includes royalty-free 32-bit DOS extender, true 32-bit Windows GUI Application Kit, our fast, tight, and reliable 32-bit Code Optimizer, licensed Microsoft Windows SDK Components, an interactive Source-Level Debugger, an Execution Profiler and More! Now includes OS/2 2.0 Support.

LIST: \$895 **PS Price: \$599**
FastFacts 1044-029



The PKWARE Data Compression Library by PKWARE

The PKWARE Data Compression Library allows software developers to add data compression technology to applications. The application program controls all data I/O, allowing data to be compressed or extracted to any device or area of memory. Only 35K of memory is needed to compress data, and only 12K is needed to extract data. Compatible with MSC, BC++, TC, TP 6.0, Clipper, Basic 4.5, 7.1, ASM.

LIST: \$295 **PS Price: \$275**
FastFacts 3043-011

SVS C3 ANSI C, Pascal, or FORTRAN-77 by Silicon Valley Software

Only from the Programmer's Shop! ANSI compliant, optimizing, 32-bit compilers; DPMI-compliant, royalty-free DOS extender; source level debugger; utilities. Supports "flat model" code. Linker, librarian, make, i387 emulation, W31/4167 support. Interoperable languages!

	LIST	PS Price
ANSI C	\$325	\$315
Pascal	\$325	\$315
FORTRAN	\$395	\$375

FastFacts 1958-048: (C), 1958-050: (Pascal), 1958-049: (FORTRAN)



Genus GX Developer's Pak by Genus Microprogramming

Incorporate graphics images into your programs quickly and easily with the GX Developer's Pak. Includes the *PCX Toolkit* which allows you to manipulate PCX graphics images; *GX Graphics* which is a complete graphics library supporting all graphics primitives; *GX Effects* which lets you add special effects to programs; and *GX Text* which allows you to display bitmapped text in any graphics mode.

LIST: \$846 **PS Price: \$695**
FastFacts 1265-013

High C/C++ v3.0 by MetaWare Incorporated

MetaWare Incorporated introduces its newest product: the 32-bit High C/C++ compiler, version 3.0. High C++ is a true compiler, not a C to C++ translator. "Incremental Strengths" lets you specify the level of C++ compilation, allowing you to migrate from C to C++ one C++ block at a time. Included in the package is a C++-tailored source-level debugger, and a 32-bit Application Development Kit for Windows. MetaWare offers a full line of multi-language, multi-platform compilers for professional software developers.

LIST: \$795 **PS Price: \$749**
FastFacts 89-063



SAYWHAT?! (v4.0) by Software Science Inc.

Designing screens should be simple! With Saywhat?!, it is! Create slide shows. A terrific prototyping tool - design user interfaces with your user in seconds! Supports all programming languages, template based code generator, mouse, moving bar menus, screen libraries. If you use dBase files, access them while building screens. Sample screens, code and utilities, plus free technical support. Upgrade policy for owners of other screen designers. 60 day money back, no questions!

LIST: \$79 **PS Price: \$75**
FastFacts 1098-001

F77L- EM/32 Version 5.0 by Lahey Computer Systems

Industry leading 32-bit Fortran Language System includes Phar Lap's 386/ DOS Extender. This VCPI, XMS, and DPMI compliant extender enables users to access up to 4GB and operate in the MS Windows DOS box. The extender is royalty free and includes virtual memory support. New with Version 5.0: 32-bit debugger, arrays beyond 16MB, compression linker, and 486 optimizations. Support for popular VAX, IBM VS, and 90 features.

LIST: \$1195 **PS Price: \$1049**
FastFacts 334-052



...For great prices and service...



Visual Basic for DOS Microsoft Corporation

Draw forms, controls; write event-procedures; create custom controls-in DOS! Create new apps or combine with existing C/C++ or Pascal code. Highly compatible with Visual Basic for Windows. Run existing Quick Basic/Basic PDS code! 80x86 compiler creates 100% standalone EXE files; 386 code generation; MOVE overlays; an integrated ISAM and much more!

Special \$199 upgrade price available to existing Microsoft and Borland language users! Call for details.

	LIST	PS Price
PRO	\$495	\$415
Standard	\$199	\$159

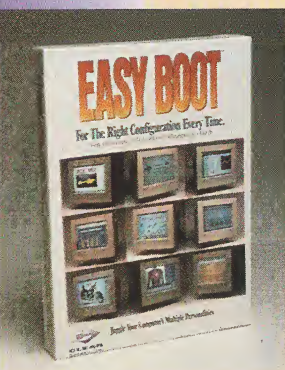
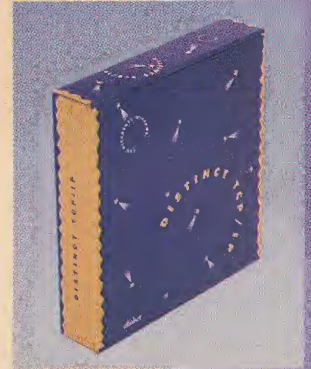
FastFacts 502-408: (PRO), 502-407: (Stand.)

Distinct TCP/IP for Windows by Distinct Corporation

Distinct TCP/IP for Windows SDK extends the TCP/IP and RPC/XDR networking capabilities to Microsoft Windows. Includes the smallest and fastest DLLs today available for Berkeley Sockets, RPC, Telnet, and FTP. Coexists on the same board with Lan Manager, Novell and Banyan. Supports Packets, NDIS and ODI drivers. Only 5KB of DOS memory required.

(SDK)	LIST: \$495	PS Price: \$439
(Applications)	LIST: \$395	PS Price: \$379

FastFacts 1951-003: (SDK), 1951-007: (App.)



Easy Boot v1.0 by Clear Software Inc.

Easy Boot allows you to maintain 15 different system configuration sets, so that you can reboot your machine with the optimal configuration every time. Maintain 15 different AUTOEXEC.BAT and CONFIG.SYS files that can easily be copied, edited and printed. It's the perfect solution to lots of accessories.

LIST: \$50 **PS Price: \$45**

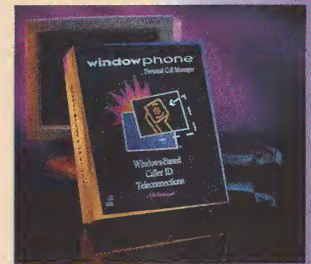
FastFacts 873-011

WindowPhone™ Software Developer's Kit by AG Communication Systems

Write applications for WindowPhone™, the personal call manager with Caller ID teleconnections. Your Windows/WindowPhone program may connect millions of home-office and corporate users to customer service databases, PIMs, order entry and much more. Includes everything needed to write customer applications: WindowPhone board, FSKSPLY utility and source code, DLL, API documentation, on-line help, developer user manual and demo program.

LIST: \$495 **PS Price: \$439**

FastFacts 4061-002



SLATE with Graphics by Symmetry Group

SLATE with Graphics is a universal printer driver library. It supports dot matrix, laser, and PostScript printers. It includes over 250 text and graphic printing functions to select fonts, print text, print images from the screen, PCX, and TIFF files, and much more. It allows royalty-free distribution of your application, the 750 printer database, and the setup and testing programs.

LIST: \$448 **PS Price: \$419**

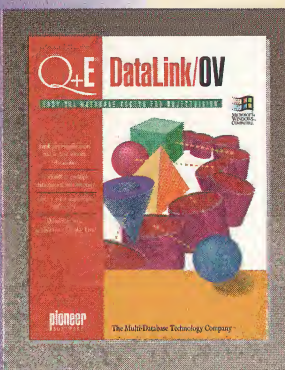
FastFacts 891-005

BLINKER 2.0 by Blink, Inc.

Fastest dynamic overlay linker for C, C++, ASM, BASIC, Clipper, QuickBASIC, Fortran, etc., with new integrated memory swap function designed to save time and memory. Automatically creates fast, stable overlaid .EXEs to reduce memory requirements. Uses XMS/EMS to save currently executing program and run a second within the first. Features CodeView support and overlay caching to XMS/EMS for optimum runtime performance.

LIST: \$299 **PS Price: \$269**

FastFacts 2933-006



Q+E DataLink/OV by Pioneer Software

Q+E DataLink/OV is a set of self registering ObjectVision @functions that enables you to link your ObjectVision application to the following databases: Btrieve, dBASE, DB2, Excel files, INGRES, NetWare SQL, Oracle, OS/2 DBM, Paradox, SQL/400, SQLBase, SQL/DS, SQL Server, Sybase, Tandem NonStop SQL, Text files, and XDB. Build complete database applications, generate reports, create customized data entry forms, execute batch updates, or perform any other database operation. **ROYALTY FREE!**

LIST: \$299 **PS Price: \$279**

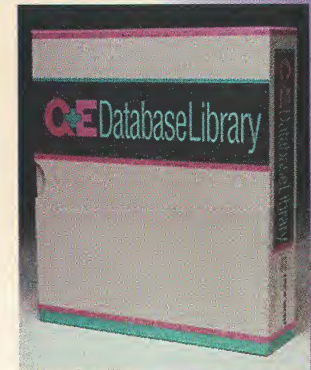
FastFacts 2137-023

Q+E Database Library by Pioneer Software

Don't rewrite code just to use a different database! Q+E Database Library and your favorite development tool can build applications that simultaneously and identically access, query, and edit data in 17 different database formats: Btrieve, dBASE, DB2, Excel files, INGRES, NetWare SQL, Oracle, OS/2 DBM, Paradox, SQL/400, SQLBase, SQL/DS, SQL Server, Sybase, Tandem NonStop SQL, Text files, and XDB.

LIST: \$399 **PS Price: \$379**

FastFacts 2137-012



To Order Call **THE PROGRAMMER'S SHOP** 1-800-421-8006

...you know who we mean. Shop the Shop.



C-Debug™ and C-Verify™ by Softran Corporation

C-Debug automatically evaluates every transaction involving data pointers and arrays. It displays variable name, source line number and an explanation of the error. **C-Verify** is a QA tool which identifies untested code. A cross-referencing tool shows the new tests required for 100% coverage. Available for DOS, OS/2, UNIX, QNX and VAX/VMS.

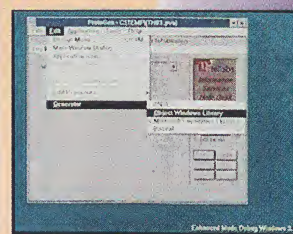
	LIST	PS Price
C-Debug	\$249	\$239
C-Verify	\$395	\$385

FastFaxes 3674-001: (C-Debug),
3674-003: (C-Verify)

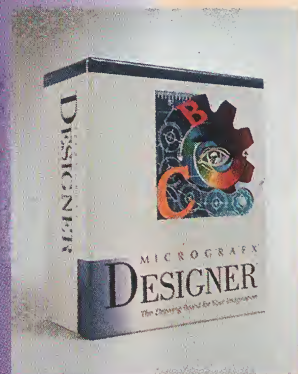
ProtoGen 3.0 by Protoview

NEW VERSION! The industry standard for code generation and prototyping Windows applications. Develop the user interface of your application using Visual prototyping methods. ProtoGen generates expert level, commented code for ANSI C, Microsoft MFC C++, Borland OWL C++, Turbo Pascal, and Microsoft NT Win32. All generators included! User Code is preserved from one generation to the next. It's easy and fast.

LIST: \$199 **PS Price: \$99**
FastFaxes 2115-009



SPECIAL PRICING



Micrografx Designer by Micrografx

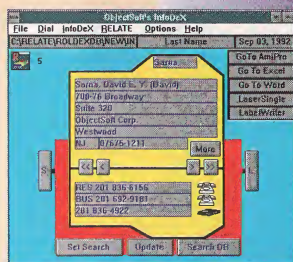
Micrografx Designer 3.1 plus OLE is the only precision illustration program for Windows. Compatible with Windows 3.0 and 3.1, Designer includes Adobe Type Manager, Adobe TypeAlign, and more than 175 Type 1 fonts. Users get 15 drawing tools, object snap, 64 layers, automatic dimensioning, OLE and TrueType font support, 2,200 clip art images, more than 30 import and export filters, and 24-hour technical support.

LIST: \$695 **PS Price: \$449**
FastFaxes 615-039

RELATE by ObjectSoft

RELATE REMEMBERS SO YOU CAN FORGET
RELATE is a personal information manager which is tightly interfaced with Word for Windows, Ami Pro, Excel and other Windows products. It allows you, within minutes, to organize your files to provide "information at your fingertips." You automatically link your documents as well as incoming and outgoing correspondence, voice notes and multi-media to a quick and easy-to-use electronic rolodex.

LIST: \$149 **PS Price: \$99**
FastFaxes 9095-001



SPECIAL PRICING

But wait, there's more: Bargains galore!

	LIST	PS
• After Dark for Windows	50	28
• Blinker	299	269
• Borland C++ 3.1	495	319
• BTrieve for DOS	595	399
• Carbon Copy Plus	199	118
• Clarion Prof. Developer 2.1	845	469
• Clipper	795	499
• CodeBase 4.5	395	295
• dBASE IV 1.5	795	529
• DesqView	220	149
• DR DOS	99	59
• Dr. Switch-ASE	180	146
• EasyCASE Professional	649	539
• Filerunner	100	79
• INSTALIT	149	119
• LapLink Pro	170	109

	LIST	PS
• Lotus 1-2-3 for Windows	595	359
• Macro Assembler (MASM)	150	99
• MS-DOS 5.0 upgrade	100	65
• MS C/C++	495	309
• MS Excel	495	329
• MS Test for Windows	395	275
• MS Visual Basic Prof. Toolkit	299	229
• MS Windows 3.1	150	99
• MS Word	450	239
• MS Word (Windows)	495	339
• MKS Toolkit	249	199
• NetLib	299	259
• Norton Desktop for Windows	179	139
• Norton Utilities	179	115
• ObjectVision	150	105
• OS/2 2.0	195	139
• PC Tools Deluxe	179	129

	LIST	PS
• Pro-C Lite w/Pro dbx	99	95
• ProComm Plus	129	89
• Q+E Database/VB	199	175
• QuattroPro	495	349
• QEMM	100	64
• R&R Code Generator	199	159
• R&R for dBASE/Compatibles	249	159
• Visual Basic 1.0	199	139
• WATCOM C 9.0/386	895	599
• Windows 3.1 upgrade	80	49
• WordPerfect	495	279
• WordPerfect (Windows)	495	299
• Xtree Gold	149	109
• 286/DOS Extender SDK	495	435
• 386/DOS Extender SDK	495	435
• 386 MAX	100	64

**Call the Programmer's Shop today:
1-800-421-8006**

Mention code BY1192

THE PROGRAMMER'S SHOP

Call FastFaxes for product information any time, day or night. 617-740-0025

Get free information on all of our more than 10,000 products any time you like • Dial from a fax machine or fax-board equipped PC • Follow the voice computer's instructions • Receive literature instantly via fax

Canada 800-446-3846
MA 617-740-2510
FAX: 617-749-2018
90 Industrial Park Road,
Hingham, MA 02043

• Credit card orders processed only when product is shipped
• All prices subject to change • International prices will vary

military, with a good approach to integrating the lessons of the Gulf War into military theory.

The computer book of the month is *Waite Group's Visual Basic How-To* by Robert Arnsper et al. (Waite Group Press, 1992). This is an intermediate programming book. Beginners will want something simpler for an introduction, but this gives oodles of examples and shows how to do some pretty tricky stuff. It was written when Visual Basic was for Windows only, but much of it is applicable to Visual Basic for DOS.

Two games of the month. First, *Hardball III* from Accolade. If you like computer baseball, you'll like this a lot; at least Richard, the baseball enthusiast in the family, does. Real play-by-play announce-

ments through Sound Blaster Pro. Second, *Gunship 2000* from MicroProse. I don't get to keep this one: my son Phillip is a Navy officer on a helicopter carrier, and the only thing those guys like better than flying choppers for real is flying them with a good flight simulator, and this way Marines can fly an Apache.

Finally, you can get the *Lost Treasures of Infocom*: 15 disks, 20 text adventures (including *Zork*, *Planetfall*, and *Bureaucracy*), and all the clue books and maps. There's no fancy graphics, but those old text games had something the modern computer games lack.

Next month: another look at palmtops, some math programs, and short shrift to a bunch of stuff that's too good to ignore but I never have room for.

And now we're off to the beach house, where with any luck I will turn out the final draft of *Janissaries IV, Hour Of Treason* and simultaneously run off 10 pounds. Wish me luck. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerry."

ITEMS DISCUSSED

Corel SCASI.....\$99

Corel Systems Corp.
1600 Carling Ave.
Ottawa, Ontario,
Canada K1Z 8R7
(613) 728-8200
fax: (613) 761-9176

Circle 1146 on Inquiry Card.

50-MHz 486DX2 EISA.....\$3695

Gateway 2000, Inc.
610 Gateway Dr.
P.O. Box 2000
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023

Circle 1147 on Inquiry Card.

Flexscan F550i.....\$1749

Nanao U.S.A. Corp.
23535 Telo Ave.
Torrance, CA 90505
(800) 800-5202
(310) 325-5202
fax: (310) 530-1679

Circle 1148 on Inquiry Card.

Gunship 2000.....\$69.95

MicroProse Software, Inc.
180 Lakefront Dr.
Hunt Valley, MD 21030
(800) 879-7529
(410) 771-1151

Circle 1149 on Inquiry Card.

Hardball III.....\$59.95

Accolade
5300 Stevens Creek Blvd., Suite 500
San Jose, CA 95129
(800) 245-7744
(408) 985-1700
fax: (408) 246-0885

Circle 1150 on Inquiry Card.

Lost Treasures of Infocom

volumes 1 and 2.....\$69.95 each
Activision, Inc.
11440 San Vicente Blvd.
Los Angeles, CA 90049
(800) 477-3650
(310) 207-4500
fax: (310) 820-6131

Circle 1151 on Inquiry Card.

MultiSync 4FG.....\$949

NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 632-4636
(508) 264-8000

Circle 1152 on Inquiry Card.

Network Archivist.....\$995

Palindrome Corp.
600 East Diehl Rd.
Naperville, IL 60563
(708) 505-3300
fax: (708) 505-7917

Circle 1153 on Inquiry Card.

OS/2 2.0.....\$149

IBM
1 Old Orchard Rd.
Armonk, NY 10504
(800) 342-6672
(914) 765-1900

Circle 1154 on Inquiry Card.

QuickPak Professional

for Windows.....\$199
Crescent Software, Inc.
11 Bailey Ave.
Ridgefield, CT 06877
(203) 438-5300
fax: (203) 431-4626

Circle 1155 on Inquiry Card.

Satisfaxtion 400E.....\$549

Intel Corp.
5200 Northeast Elam Young Pkwy.
Hillsboro, OR 97124
(800) 538-3373
(503) 629-7444
fax: (800) 525-3019

Circle 1156 on Inquiry Card.

Visual Basic for DOS.....\$199

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329

Circle 1157 on Inquiry Card.

WinSleuth Gold 3.0.....\$169

Dariana, Inc.
5241 Lincoln Ave., Suite B5
Cypress, CA 90630
(800) 892-9950
(714) 236-1380
fax: (714) 236-1390

Circle 1158 on Inquiry Card.

Word for Word.....\$149

MasterSoft
6991 East Camelback Rd.,
Suite A-320
Scottsdale, AZ 85251
(602) 277-0900
fax: (602) 970-0706

Circle 1159 on Inquiry Card.

Penny-Pinching PCs:

How They Did It

Before buying a budget PC,
know which corners the vendor has cut

ANDREW REINHARDT

The dramatic plunge of PC prices in the last nine months has touched off a fundamental restructuring that will leave the PC industry forever changed. PCs will be made, marketed, and sold differently. Only the strongest, smartest vendors will survive. For the consumer, the benefits are great, but so are the risks.

On the upside, you will pay less for computers now and in the future, as they have become commodity items. As vendors' profit margins erode, they will be forced to find new, innovative ways to add value. Base systems will be configured more tightly to specific types of user needs.

However, buyers must be more careful than ever when choosing which PC to buy. Cutting prices usually means cutting corners, as vendors use less durable parts and eliminate features. Today's bargain PC might become tomorrow's orphan as weaker clone vendors fail, leaving their customers without support. By reducing R&D funds, companies could sacrifice their future to gain market share today.

Ironically, the catalyst for the PC price plunge was the move of vendors of traditionally high-priced products into the low-cost world. Compaq, AST Research, DEC, and IBM, among others, have introduced new PC lines that compete directly with those of the bottom-feeding clone vendors. Risking their reputations as providers of superior-quality systems in an effort to survive, these vendors have brought prices down using both innovation and good old-fashioned cost cutting.

The BYTE Lab tore apart six low-cost systems from Compaq, Dell, AST, IBM, DEC, and Apple to see exactly what you get for your money (see the text box "Less Expensive, or Cheap?" on page 132). Although all six companies made some trade-offs with these systems, they have maintained a high level of quality: A Compaq is still a Compaq, even at \$1000.

A Folding Umbrella

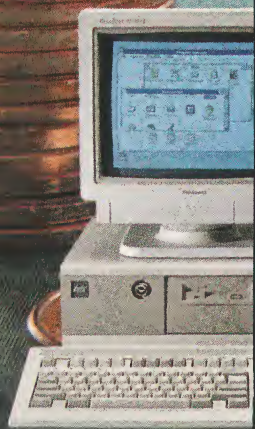
In the past, as long as giants such as IBM, Compaq, and Apple kept prices high, clone makers had a fertile ground for selling less expensive systems to a hungry market. But when the giants dropped their prices to clone levels, the so-called price umbrella collapsed.

"Everybody suddenly realized that you didn't have to buy IBM and Compaq; brands like Gateway were acceptable," says David Blitzter, vice president and chief economist for Standard & Poor's in New York. The result was a steadily decreasing market share for vendors of high-priced products; according to Benny

Compaq
ProLinea 3/25zs



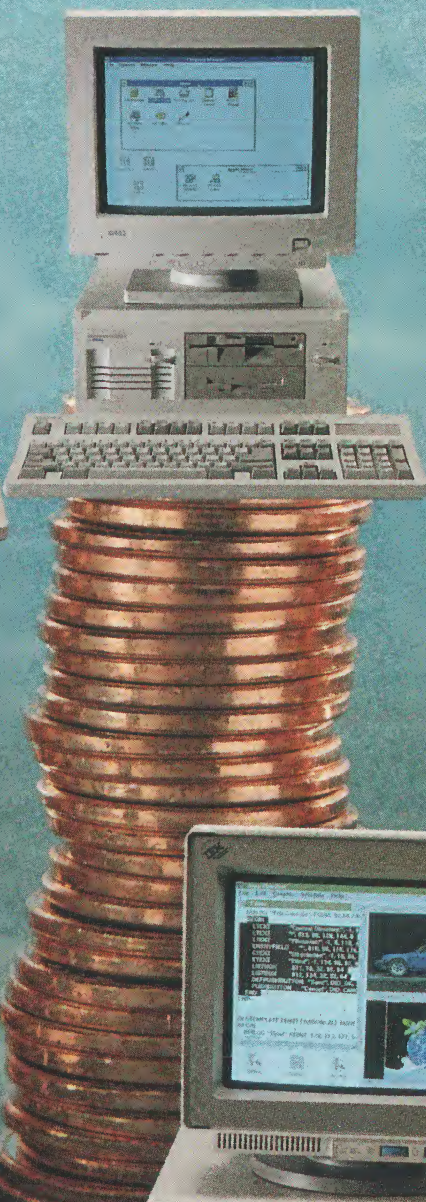
AST Bravo 4/25s



**Digital
DECpc 333sx LP**



**Dell Dimension
386SX/25**



**Apple Macintosh
Performa 600**



IBM PS/ValuePoint 325T

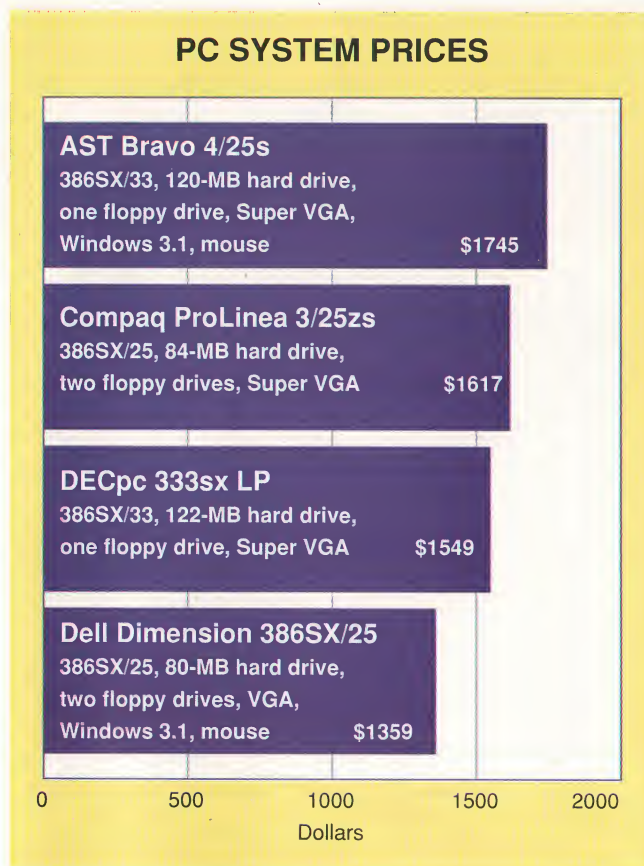


Figure 1: Standard equipment for each of the systems compared here varies, but each listing represents the respective company's entry-level system. All come with 4 MB of RAM, MS-DOS 5.0, and a monitor. The Compaq and AST prices are retail, while the DEC and Dell prices are direct. Dealers generally discount retail prices, although the percentage varies. AST estimates the street price of the Bravo to be approximately \$1500. IBM had not yet released pricing on its ValuePoint line at press time.

Lorenzo, an analyst for the investment firm Dillon, Read, 50 percent of the market now belongs to off-brand clones.

Competition heated up in 1991, as a soft economy led to an overall 25 percent price decline in systems. Then, last February, Dell cut its prices by up to 38 percent; Tandy, DEC, Everex, CompuAdd, AST, Zenith, and Apple followed suit. In Europe, Siemens Nixdorf introduced a line of low-cost PCs. In May, IBM trimmed prices on its PS/2s, in some cases offering direct-order models below dealers' wholesale prices.

The turning point in the price war was Compaq's June introduction of its low-cost ProLinea line, which launched a new torrent of price cuts throughout the industry. IBM has since followed with its PS/ValuePoint line, and DEC recently introduced a low-cost line of PCs made in Taiwan (see figure 1).

Compaq's new ProLinea line is intended to complement its Deskpro series. Compaq wasn't the first to implement a dual-product-line strategy; AST and Advanced Logic Research, for example, have long offered different families targeted toward corporate and individual buyers. But with its clout, Compaq has accelerated the move toward a price-driven market. "This is happening a lot faster than anybody anticipated," says Sheridan Tat-

suno, president of NeoConcepts, a consulting firm in Aptos, California, specializing in the Asian market.

Early reports indicate that, at least for Compaq, sales of low-cost, name-brand PCs are doing very well. Harry Henry, director of research at market research firm Computer Intelligence/Storeboard, says that Compaq moved about 10,000 ProLineas of all models through the retail channel in July, from essentially zero the month before. "Talk about a rebound," he says. In fact, Compaq is backlogged on ProLinea orders, although the company expected production to meet demand sometime last month.

Despite signs of success, not everyone believes the dual-line strategy is good for the long term. Chris Buckham, marketing director for U.K. computer maker Apricot, calls IBM and Compaq's decision to enter the low-price market "a panic decision to a passing trend that peaked some six months ago." He believes that as buyers sour on lower-quality machines and direct sales, "there will be a backlash against cheap machines; not everybody wants to drive a Lada." Noting that only 30 percent of systems in the U.K. are sold direct, he asserts that "the other 70 percent are sold to people who are interested in more than price."

Cutting Costs or Corners?

Vendors are coping with a mix of lower profit margins and reduced spending on everything from salaries to advertising to customer support. But much of the effort is focused on reducing the cost of systems themselves, through an interrelated combination of design changes and revised manufacturing processes.

The costliest parts of most systems are the hard drive and the motherboard (see figure 2). Other than renegotiating supplier contracts, manufacturers can do little to reduce these expenses. Many companies have turned to AMD and Cyrix for CPUs, which has prompted Intel to slash its own prices.

This leaves the rest of the motherboard as a prime target for cost reduction, says Roger Alford, a system designer with Programmable Designs and a BYTE consulting editor. Companies are designing "universal" motherboards that can accept a wide range of processors, from a 386SX up to a 486DX2. Many companies are reducing the number of PCB (printed circuit board) layers from six to four, for a savings of 20 percent to 40 percent per board. And all companies are seeking to reduce part counts wherever possible by using highly integrated chip sets.

Vendors also contend that some lower-rated parts can be used without affecting quality. "Everything was specced very robustly when the industry was young," says Daniel Sheppard, director of product marketing for AST Research. By using a less expensive SIMM socket, for example, AST is saving tens of thousands of dollars per year. The company most notorious for overengineering was Compaq, says Gerald Purdy, director of corporate marketing for Sundisk and former director of portable computer systems at BIOS vendor Phoenix Technologies. "Compaq was religious about this," he says. "They way-overspecced their systems." Many of those high specs, such as an external cache on the 386SX and extra RFI shielding, were the first to go when Compaq designed the ProLinea.

AST Redesigns Its Systems

Sheppard says AST has reduced costs by 35 percent while improving serviceability in its new Bravo systems. The reductions came from changes that saved anywhere from a few pennies to tens of dollars.

The most noticeable change is a new L-shaped universal motherboard that has only four layers instead of six. The unusual shape allows AST to punch out two motherboards from each sheet of PCB material, a raw savings of 50 percent. A new chip that AST codeveloped with VLSI Designs integrates all core

logic into a single device. A "personality slot" on the motherboard permits users to add in features formerly on the motherboard, such as a network interface, without using up an ISA bus slot.

Some of the modifications implemented with the Bravo systems are minor. AST uses a less expensive speaker than before. The SIMM sockets, formerly rated for 1000 insertions, are now rated for 30. "How many times do you change your memory configuration?" asks Sheppard. "We save 2 cents on each socket, and that adds up because we buy millions." Likewise, serial and parallel connectors rated for 10,000 insertions were replaced with less expensive parts that will still outlast most users.

Some changes reflect different usage patterns. Because floppy drives see less use than in years past, Sheppard says AST can specify lighter-duty units. The same holds true for the floppy media shipped with systems. AST also cut 6 inches from the length of the keyboard cable. "Once upon a time, somebody decided 3½ feet was the right cable length," Sheppard says. AST now saves 200,000 feet of cable a year.

Some areas were off limits. "When you mess with the keyboard, you get into trouble because of ergonomics," Sheppard says. AST also kept the reset button on the front panel despite potential savings in moving it. The power supply, too, must meet exacting standards, but AST is saving money by using a unit in U.S. systems that meets FCC and UL ratings but not the tougher Nordic standards.

Cutting corners can lead to problems. Dave Kirkey, vice president of sales and marketing at ALR, warns that discount motherboards can delaminate. Programmable Designs' Alford is wary of inexpensive connectors, which can be unreliable. He is especially disturbed by the practice of substituting 8-bit RAM for parity-checking 9-bit RAM. "This saves RAM chips and the parity-generation and checking circuitry," he says. "But without parity checking, the system cannot detect RAM failure while it is running."

Hewlett-Packard, long known for quality, is seeking ways to trim costs from its Vectra line, built in Grenoble, France. Like the Compaq ProLinea, HP's new Vectra 486N uses an 85-watt power supply; since the system has limited expansion capability, the company claims a more powerful unit isn't needed. Product manager Alison McCallum-Varey says the 486N and the earlier 386N contain a total of about 450 parts, a 46 percent reduction from the approximately 840 parts used in the older Vectra QS16S. The lower part count saves HP money in raw materials, inventory management, assembly, testing, and service (see table 1). Another design focus was to reduce the number of screws on the motherboard, which saves on both manufacturing and service costs. "If you look at a Dell motherboard, it has about 25 screws," McCallum-Varey says. "Ours has just one screw, which we are working to get rid of."

Compaq Streamlines Manufacturing

For Compaq, designing a low-cost PC involved as many changes to process as to product. The company initiated a continuous-flow assembly line, where products go straight from board assembly to systems assembly, eliminating work-in-process queues. The company also reduced redundant testing of subassemblies; only a statistical sample of boards are evaluated before being installed in systems, and then all completed units are fully tested and burned in. Keith Maxwell, manager of new-products manufacturing for Compaq, says these process changes reduce inventory-carrying costs and the more substantial expense of rework.

Compaq has also implemented a flux-free soldering process that saves a washing step for PCB assemblies and conveniently eliminates the use of ozone-depleting chlorofluorocarbons. In

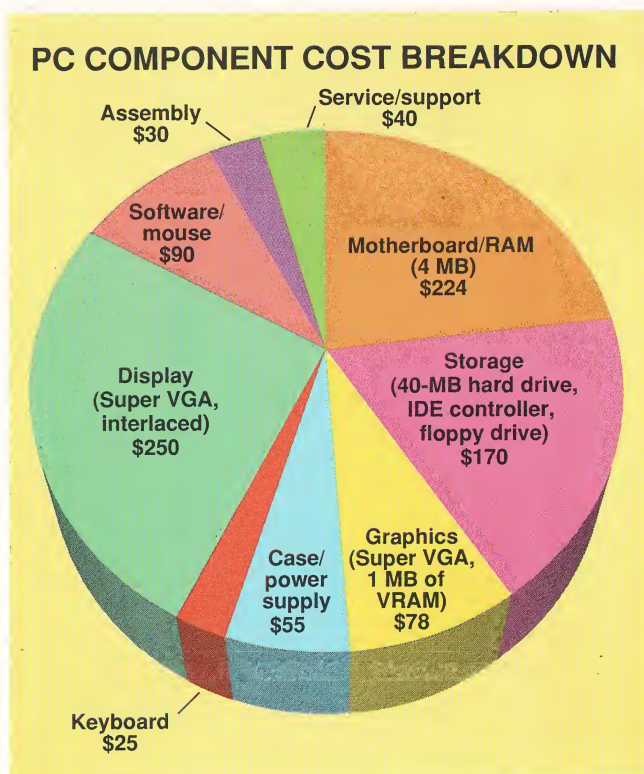


Figure 2: BYTE compiled this breakdown of component cost using a variety of sources, including system vendors, design engineers, and analysts. Specific costs vary from manufacturer to manufacturer. The bulk of the cost is concentrated in a few areas, one of which, the motherboard, is a prime target for vendors to reduce costs.

the realm of innovative accounting tricks, the company now stores completed systems inside rented trucks, which reduces its inventory tax liability. In the cutthroat world of low-cost PCs, you take your savings where you can find them.

AST's manufacturing is also tuned for low-cost systems, says Darius C. Power, managing director of the company's U.S. manufacturing. Power touts AST's commitment to concurrent engineering—the simultaneous development of product and process—which he says cuts both cost and time to market. AST uses an integrated materials-handling system and an automated shop-floor control system that manages everything from statistical quality control to system configuration to the downloading of test routines appropriate for each system. The company is constantly looking for ways to reduce cycle times: updating sales projections more often, propagating projections faster through the production scheduling system, and placing parts orders more quickly. "Any manufacturing technique can be successful," says Power. "It's the culture and efficiency that dictate whether or not it works."

Whether through design or manufacturing, argues NeoConcepts' Tatsuno, the ultimate goal for manufacturers must be simplification. "A danger for U.S. designers is that they love to get involved in complex technology," he says. To survive in the "ruthless" world of consumer electronics, he says, "the only way to cut costs is to eliminate complexity. The companies that survive will be the ones that reduce costs by 30 percent to 40 percent per year."

Although Apple has remained largely neutral during the recent

Less Expensive, or Cheap?

STEVE APIKI AND TOM THOMPSON

YOU CAN'T MAKE A PERSONAL COMPUTER FOR LESS MONEY WITHOUT CUTTING AT LEAST ONE OR TWO CORNERS. WITH THIS IN MIND, THE BYTE LAB EXAMINED THE DESIGN TRADE-OFFS OF SIX LOW-COST SYSTEMS FROM BRAND LEADERS: COMPAQ'S PROLINEA 3/25ZS, DELL'S DIMENSION 386SX/25, IBM'S PS/VALUEPOINT 325T, AST'S BRAVO 4/25S, THE DIGITAL DECPC 333SX LP, AND APPLE'S MAC PERFORMA 600. THE QUESTION WE WANTED TO ANSWER WAS, ARE THESE INDEED HIGH-QUALITY SYSTEMS AT A LOWER COST, OR ARE THEY SIMPLY CHEAP?

Compaq ProLinea 3/25zs

The ProLinea 3/25zs is Compaq's least expensive system. What it most obviously sacrifices is expansion capability: Missing are a high-capacity power supply, an EISA bus, and lots of slots. While more slots and more drive bays are available in other ProLinea models, expansion and serviceability remain the areas where the ProLinea shows the most change from Compaqs of old.

Still, Compaq has built a high-quality, cost-effective machine. The motherboard and support ASICs (application-specific ICs) are all designed and manufactured by Compaq. The Pro-

Linea's main board shows the same commitment to surface-mount components as does the system board of a Deskpro 386/33L (see photo A). The ProLinea is a more highly integrated system than the Deskpro. High integration and heavy emphasis on surface-mount components have made the ProLinea much smaller and less subject to faulty mechanical connections. These qualities have also let Compaq switch from the eight-layer, double-sided board of its older Deskpro to a less expensive, four-layer, single-sided PC board.

Shrinking the size and the expansion capability of the ProLinea shaved a lot of expense. Fewer expansion slots means a lower power-supply capacity, less demanding cooling requirements, and a smaller case with less need for reinforcement and shielding. Since expansion is so deemphasized, the ProLinea's case is not designed for ease of access. Screws, rather than thumbscrews, attach the cover, and the hard drive is inaccessible without removing the power supply.

Important components in the ProLinea remain top-notch: The 40-MB hard drive in the 3/25zs comes from well-regarded Quantum. The integrated video system is based on a Western Digital WDC-90C11, a solid—if not outstanding—VGA platform.

But Compaq did compromise on a few features. The old, heavy, mechanical Compaq keyboard is replaced on the ProLinea by a lighter, membrane-switch device that lacks the solid feel of

the older keyboard. Gone, too, is the large proprietary power supply of the Deskpro, replaced by a standard 70-watt unit. Some traditional Compaq "overengineering" items—external cache on a 386SX, several layers of drop-in RFI shields, proprietary memory modules populated with RAM from only a few select sources—have also

fallen by the wayside in the ProLinea. On the positive side, Compaq's use of standard components means you have third-party sources for ProLinea replacement parts.

The ProLinea still has what it takes in the important areas. Performance is good, and its high level of integration should make it a reliable system.



Compaq ProLinea

Dell Dimension 386SX/25

Dell has earned respect by manufacturing solid systems at a reduced cost to the buyer. In this sense, Dell had less to cut than Compaq in delivering its low-cost Dimension line.

The most obvious change between the Dimension and Dell's standard P series is that the Dimension's system board is made by SMC, not Dell, and the system is assembled by another contractor. While the 333P (a 386DX system) uses a six-layer board, the Dimension's board is a sim-



Dell Dimension

PC price wars, the company has been quietly reducing costs as well. Part of Apple's strategy is to accept somewhat lower profit margins, which are still among the industry's highest at 44 percent. But beyond that, Apple is seeking ways to economize without using lower-quality parts.

For example, the new Mac Performa 600—the highest-end model in Apple's line of home Macs—dispenses with the relatively costly aluminum coating that is sprayed inside the cases of other Macs to meet the FCC Class B standard for RF emissions.

Instead, the Performa 600 has a sheet-metal casing that costs less to manufacture and easily exceeds the Class B rating.

On the Performa 600's motherboard is a new custom ASIC (application-specific IC) Combo chip that combines the SCSI-controller and serial-controller chips. Marc Auerbach, a Macintosh product manager, says Apple is developing even more integrated ASICs to reduce the size of motherboards, make the boards easier to manufacture, and improve reliability.

Another method that Apple is using to cut costs is reduced

pler four-layer design. It lacks the modular CPU and cache-upgrade features of Dell's P series, which allows you to add cache memory or upgrade to a 486 with an option card. The Dimension also includes standard 30-pin SIMMs, versus the 333P's larger SIMM boards.

The Dimension still has good components, like a Conner IDE drive and 90C11-based VGA on-board. However, some of the nice touches of the P series have been cut. The Dimension's keyboard is much lighter than and lacks the feel of Dell's standard design. Although the drive controller, video, and I/O ports are integrated on the motherboard in both series, the Dimension board uses less-solid plug-in connectors for I/O and video in places where the P series has ports soldered to the board. Also, the Dimension's motherboard fits poorly in its case; the board has six ISA slots, but only four are accessible externally, and the chassis has room for only four cards. However, the Dimension also scores a few points over the slimline P series: It has more slots (the 333P has only three) and a larger power supply (150 W versus 84 W).



IBM PS/ValuePoint

IBM PS/ValuePoint 325T

The PS/ValuePoint may be IBM's idea of a low-end, low-cost system, but cost compromises are few and far between on this very solid design. High integration, standard rather than custom solutions, and existing IBM technology put to good use are the keys to the ValuePoint 325T's low price.

IBM's 386SLC processor, with its built-in 8-KB cache, gives the ValuePoint a slight performance edge over other 386SX-based systems. It also saves IBM from having to dedicate

board space and additional external logic to maintaining an external processor cache.

The ValuePoint's four-layer, single-sided board is larger than that of the ProLinea, but it has about 20 percent fewer ICs. The high-integration support chips are from VLSI Designs and Oki/IBM. The system board has a built-in video and IDE controller, 2 MB of DRAM, and two plastic sockets for large SIMM boards. You can put in two more SIMM modules for a total of 18 MB, but the memory-support hardware supports only 16 MB.

The ValuePoint's on-board video is Super VGA, not XGA. The Super VGA is provided by a Cirrus 5422, a high-speed video controller that includes a 24-bit RAMDAC. There's also 1 MB of VRAM (video RAM) on-board, in just two memory ICs.

There are a few cheap points: a 145-W power supply to drive four drive bays and five ISA slots, a small piezoelectric speaker that doesn't deliver much of a beep, and a 3-volt coin battery for CMOS backup. But the big components are excellent: an IBM 80-MB IDE hard drive and a nice, heavy IBM keyboard.

The case has a plastic front bezel that snaps on with a plastic clip. The rest of the case contains a lot of metal, with a reinforcing bar across the middle of the chassis. The drive bays pop out easily with a few screws.

AST Bravo 4/25s

AST reduced cost long before it was cool; the company introduced its low-end, cost-cut Bravo series in 1988. In September, AST rolled out its most inexpensive Bravo line to date, which cuts cost even further, primarily

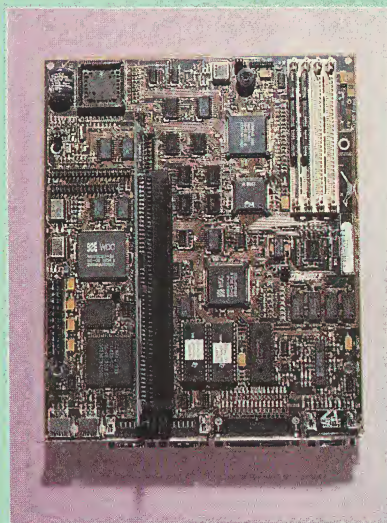
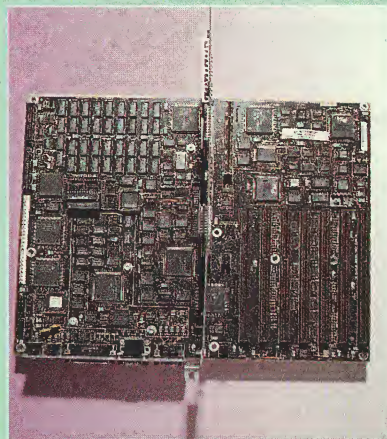


Photo A: Old Compaq versus new: Compaq's older Deskpro 386/33L (top) includes a large, eight-layer, double-sided board; a custom power supply; and plenty of room for expansion. Compaq's new low-end ProLinea (bottom) is a much smaller ISA system that's based on a single-sided, four-layer board and runs on a standard power supply.

packaging, which has environmental benefits, too. For instance, most Macs come in boxes that are 20 percent to 25 percent plastic foam, while the Performa 600's packaging is only about 17 percent foam.

Still another approach is to recycle proven designs. The Mac LCII, introduced last spring, uses the same motherboard as the older LC. The LC's 68020 chip has been replaced in the LCII with a 68030, and the system includes 4 MB of RAM soldered to the motherboard instead of 2 MB. This money-saving shortcut en-

tailed a trade-off, however. When you add two 4-MB SIMMs, the LCII has a total of 12 MB, but it can address only 10 MB, because Apple saved months of development time by not redesigning the LC's memory controller.

Survival of the Fittest

Sometimes, says Ronald Chwang, president and CEO of Acer America, "you have to reengineer the whole company." With labor representing a fairly small portion of total system cost—

BYTE LOW-LEVEL BENCHMARK RESULTS

Table A: Although vendors cut a few performance features in these low-cost designs (e.g., scrapping the processor cache), system speeds remain respectable. All indexes are relative to a Compaq Deskpro 386/33L, which has an index of 1.

	AST Bravo 4/25s	Compaq ProLinea 3/25zs	DECpc 333sx LP	Dell Dimension 386SX/25	IBM PS/ValuePoint 325T
CPU index	0.95	0.45	0.87	0.39	0.49
Disk index	1.07	1.04	1.15	0.97	1.04
Video index	1.11	0.57	1.08	0.53	0.90

through advanced integration.

The new Bravos are built around a redesigned system board, like the ProLinea's system board. All 486-class Bravo systems use the same motherboard, which can provide clock frequencies of between 16 and 40 MHz. Thus, you can plug any 486 CPU into it. The board also includes a soldered-on 486SX chip and space for an optional daughtercard. The daughtercard supports an Intel OverDrive processor and cache module; other Bravo models are built around the same system board with different CPU and cache combinations on the add-in card. The on-board 486SX is depopulated on factory-configured DX and DX2 systems.

The common 486 board is an L-shaped, four-layer, double-sided PCB (printed circuit board). The motherboards of older Bravos were six-layer designs and about twice as big. AST claims that the L shape and reduced size of the new boards enables the company to print two boards at a time instead of just one.

Despite its small size, the new board is only moderately populated. The heart of the system is a highly integrated VLSI Designs chip set that accounts for most of the system logic. The



AST Bravo 4/25s

largest consumer of board real estate is the on-board VGA, which includes a Cirrus 5422 VGA controller (including a 24-bit RAMDAC) and 1 MB of VRAM. Serial and parallel I/O and an IDE controller are included on the system board. Finally, there is a proprietary connector designed to accept a network interface daughtercard.

Except for the system board, very little has changed from the last Bravo. The chassis is the same—a relatively cheap, mostly plastic case that disassembles easily and has room for four half-height drives. The unit the BYTE Lab looked at included a reliable Western Digital IDE drive. The power supply is also similar to that used on older models, although AST now ships different ones according to the standards of the country of destination.

AST also saved small costs by using a cheaper, clip-on coin battery and a cheaper speaker. But surprisingly, the new Bravo looks like a better machine than its more expensive predecessor; it's more highly integrated, and it packs more features into the same case.

DECpc 333sx LP

Unlike DEC's Tandy-built mainstream desktops, the LP series is assembled

entirely in DEC's Taiwan facilities. The shift to lower labor costs undoubtedly contributes to DEC's aggressive pricing. But the LP series also shaves cost through its design—with high integration and limited expandability.

The main system board on the DECpc 333sx LP is a well-made, four-layer, double-sided PCB. Like the other manufacturers, DEC cut price while improving reliability by using highly integrated parts. The heart of the 333sx is an Eteq Panda chip set (an 82C390SX), a single chip that incorporates most of the support logic required for a 386SX design. As a result, the board has plenty of free space; the only other significant support chip is a Chips & Technologies 82C206 CMOS/clock device. There is room for eight SIMM modules on the system board, and each socket accepts 4-MB SIMMs. However, the Panda supports only 14 MB of total system RAM. The SIMM sockets use metal, not plastic, clips.

The Eteq chip includes 64 KB of cache memory and a cache controller. The 333sx LP runs on an AMD 33-



DECpc 333sx LP

around 10 percent—and material costs relatively equal across suppliers, the management challenge has become quality of execution.

Among the techniques for reducing costs are vertical and horizontal integration, use of off-the-shelf parts instead of custom designs, and leaving out options. One sign of how much the market has changed, however, is that other long-standing methods of cost reduction, such as outsourcing subsystems and manufacturing offshore, now run afoul of more-pressing needs for invento-

ry reduction and fast turnaround.

Acer used to manufacture systems in Taiwan, where it is based. Now, says Chwang, "it doesn't matter where you manufacture; the key is how you manage inventory." Product life cycles have shrunk from as long as one to two years to as short as three to six months. Better-informed customers demand freedom to configure systems. The solution is to assemble PCs at the last possible minute, minimizing inventory on hand and maximizing flexibility. "When product spends six weeks on a boat, you lose money,

MHz 386SX, and the combination of 33-MHz operation and cached memory provides good performance.

Other components of the 333sx are outstanding. DEC's integrated VGA is a Cirrus 5422, the same 24-bit device used in the ValuePoint and Bravo. The 52-MB hard drive is from Quantum. The power supply is a 145-W unit manufactured by Delta with a variable-speed fan for noise reduction. It's not a cheap supply, and 145 W is not bad for the three slots and four drive bays that the 333sx LP needs to support.

The case is not rugged, but it's very well thought out. Drive cages pop out with just a few screws. A single connector runs from all front-panel switches and indicators to the system board. The only obvious cost reductions are in the flimsy case lock and clips.

The 333sx is somewhat of an anomaly in the LP line, which is designed to share as many components as possible among systems—a major source of savings. All the LP systems share the same case, power supply, and drives. The 32-bit members of the LP line share a common motherboard, with a daughtercard for processor-specific features. However, the 333sx has a system board all its own. According to DEC, adding 16-bit data paths to the general-purpose board would add more cost than designing and stocking a dedicated 386SX motherboard.

Mac Performa 600

The Performa 600 closely resembles the 25-MHz Mac IIci and has all the features you'd expect from a Macintosh: three NuBus slots, virtual memory, built-in color video, and sound I/O.



Mac Performa 600

Apple offers this 32-MHz, 68030-based Mac with extra features and a built-in CD-ROM for around \$2500.

The Performa 600 has plenty of expansion capability. At the front is a half-height bay. A smaller internal bay holds a 3½-inch drive. Both bays support SCSI peripherals. The 112-W power supply is a universal type.

The Performa's built-in video supports 8-bit-deep displays of 640 by 480 pixels on 13-inch and VGA monitors. However, the Performa's video frame buffer resides in 512 KB of VRAM, while the IIci's frame buffer consumes a portion of main memory. Furthermore, this VRAM buffer can be expanded to 1 MB, so the Performa 600 can display 16-bit pixels (32,768 colors)—a feat the IIci is incapable of achieving.

A glance at the Performa 600's main logic board shows a high level of integration. The 68882 FPU is gone, but there is a socket for one for those who need it. The board has only four SIMM RAM sockets and two SIMM VRAM sockets. You can expand memory by replacing the existing SIMMs with

higher-density ones.

A Combo chip on the main logic board combines the functions of a 53C80 SCSI controller chip and an 85C30 serial controller chip. Borrowed from the IIci is a 68HC05 microcontroller that eliminates several custom chips by integrating the Apple Desktop Bus logic, real-time clock, power control, and parameter RAM.

A custom ASIC, called the Vasp, consolidates the clock-signal, video-generation, and memory-mapping functions that required several chips in the Mac IIci design. The Vasp also incorporates the sound circuitry found in another ASIC on the Mac LC and LCII.

Although the Performa 600's CPU is clocked at 31.334 MHz, the bus operates at only 15.667 MHz. This allows the use of inexpensive 80-nanosecond RAM, but it also exacts a performance penalty: The CPU and FPU often wait for memory reads and writes to complete.

Steve Apiki is a technical editor for the BYTE Lab. You can reach him on BIX as "apiki" or on the Internet at apiki@bytepb.byte.com. Tom Thompson is a BYTE senior technical editor at large. You can contact him on BIX as "tom_thompson."

BYTE LOW-LEVEL BENCHMARK RESULTS

Table B: *The feature-rich Performa 600 suffers only in system performance, due to its 16-MHz bus. All indexes are relative to a Mac Classic II, which has an index of 1. All tests were run with the displays in black-and-white mode to match the Mac Classic II's screen depth. The benchmarks were run on a prototype system and should be considered preliminary.*

	Mac Performa 600	Mac SE/30	Mac IIci
CPU index	1.54	1.39	2.17
Disk index	1.74	1.24	1.29
Video index	1.55	1.23	1.94

and your lead time to change configurations is too long," Chwang says.

Parts that change infrequently, such as cables and cases, are made in Taiwan and are then shipped to Acer by boat. Motherboards, minus the CPU, arrive by air freight. Only days before the finished systems are sent to stores, locally purchased CPUs and hard drives are dropped in. Acer is therefore able to avoid paying import duties on the chips and is able to take advantage of the latest prices. Says Chwang, "This lets you use the hottest

CPU of the month."

Chwang also believes that vertical integration is an important asset. Acer manufactures its own keyboards and monitors and designs 70 percent to 80 percent of the ASICs in its systems, as well as its own BIOS. "We gain a cost advantage and the opportunity to add value compared to someone who buys standard components off the shelf," Chwang says. Adds ALR's Kirkey, "One of the most important things is having in-house chip-design capability."

continued

HP CUTS PART COUNT

Table 1: Hewlett-Packard reduced the number of parts in the Vectra 386N Model 50 to 452 from a total of 844 in the Vectra QS16S Model 40 a year ago.

	QS16S	386N
CPU complex	503	228
Video system	160	119
Multifunction card*	110	76
Mechanical parts	67	27
Number of cards	4	2
Total parts	844	452

*Includes one serial and one parallel port and a hard/floppy drive controller.

But not everyone agrees with this view. Compaq reduced costs of its ProLinea line in part by moving away from its normal (and expensive) habit of designing custom components. And Dell, which already did less in-house design than Compaq, turned to outside suppliers for major subsystems in its Dimension computer line. Argues Ming Hsu, president of OEM supplier Asina Computer Systems, "The notion of vertical integration in the U.S. is not an advantage when functionally identical, reliable components can be obtained at significant cost savings from outside sources."

Another approach is to seek horizontal integration. Tatsuno predicts that even companies the size of Dell won't be able to go it alone and will need to seek technology, marketing, or manufacturing partners. "We'll see acquisitions by the majors of smaller companies that own market niches," he says. "This will produce economies of scale and a kind of horizontal integration more like that of GM and Ford than that of the vertically integrated Toyota."

New PC Order

The result of this price restructuring will be a dramatically different market. Tatsuno believes there will be a lot of failures and mergers. Paul Saffo, a research fellow at the Institute for the Future in Palo Alto, California, has a bleaker view. "This is the fire sale before the storm. The clone makers are doomed. They had better take the money and run," he says.

The change is permanent. "This is not a six-month correction, where prices plummet and then go back up," says Todd Bakar, an analyst with investment-banking firm Hambrecht & Quist in San Francisco. He sees the restructuring as a sign that the PC industry is maturing.

In a mature market, a company can sell different products to different buyers. Lorenzo says that profit margins on high-end systems and servers can range up to 40 percent or 50 percent, whereas low-end PCs run from a loss of up to 22 percent. By selling a range of systems, companies can achieve both high unit volume and high profits: For example, according to analysts' estimates, Apple earned overall profit margins of 44 percent last year due to the success of its higher-priced Quadras, Mac IIs, and PowerBooks.

Jeff McNaught, a PC product manager for Wyse Technology, says his company summarizes *differentiation* as "slots, watts, and bays." High-end systems offer a lot of all three, but "to build a truly low-cost system, you have to cut some out." But Blitzer argues that the job goes beyond just products; he says differentiation is "more in the marketing and perceptions than in manufacturing." Assuming that all systems offer a similar baseline (i.e.,

an Intel-compatible CPU, a hard drive, and VGA graphics), he predicts that service, support, and distribution channels will determine who buys what.

This view is echoed by Apricot's Buckham, who divides the market into three classes of users: price-dependent, brand-dependent, and value-dependent. Price-dependent customers will buy any PC at the lowest price; the brand-dependent are swayed by brand names; and the value-dependent balance the price, feature set, and vendor reputation. To satisfy value-dependent customers, he says, you have to invest heavily in R&D to add extra features.

R&D Cutbacks

Too much focus on rock-bottom pricing could dampen innovation and delay the wide adoption of newer technologies such as higher-capacity floppy drives and multimedia. "[When you focus too much on pricing,] you tend to eliminate some of the high-risk R&D efforts," says Acer's Chwang. Features that might make PCs more enticing to buyers—stereo sound, faster graphics, CD-ROM, on-board DSPs (digital signal processors)—are left out to cut costs. Unfortunately, this will beget a vicious cycle: Because these add-ons will remain nonstandard, they won't sell at the volumes necessary to drive down their cost. And with profits squeezed, vendors will see opportunities for high profit margins in options, thus keeping prices up and further reducing their volumes.

But most observers don't believe creativity is in jeopardy. "In the future, you'll have to innovate to make any money," says Esther Dyson, editor of the *RELease 1.0* newsletter. "We'll see a lot of price cutting and then a wave of innovation as a means of differentiation." Indeed, some argue that by aggressively stripping cost out of the basic PC unit, manufacturers will actually find it easier to sell advanced features.

Innovation, not cost cutting, will ultimately win the market. "Companies need to continue to develop new technologies and invest in R&D," says Hambrecht & Quist's Bakar. "It would be a big mistake to sacrifice the future."

Maintaining high R&D spending is a formidable challenge in an industry with tight profit margins. Compaq has already cut its spending levels: In the first half of 1992, it spent \$89 million on R&D, compared to \$101 million for the same period in 1991. On average, PC vendors spend about 1 percent of the cost of a PC on R&D, says Krish Shetty, managing director of Nascom Computer in North Andover, Massachusetts. Companies such as AST and Compaq spend approximately 3 percent. IBM might spend as much as 5 percent.

Tatsuno argues that the computer industry will have to follow the model of consumer electronics firms. "The Japanese learned that the only way [to succeed in consumer electronics] is with huge volumes," he says. "In five years, we'll have hundreds of millions of machines; companies will be making 2 percent to 3 percent margins, and they'll reinvest 40 percent to 45 percent of that back into R&D. That's the name of the game."

Companies will have to balance their immediate need to remain in business with a long-term view that allows them to pioneer new markets and invest in new technology. Says Bakar, "It's obvious that Apple, Compaq, Dell, and AST will prosper. But beyond them, it becomes less clear." ■

Editor's note: *BYTE's* U.K./Europe bureau chief Andy Redfern and *BYTE* news editors Patrick Waurzyniak, Tom Halfhill, and Ed Perratore also contributed to this story.

Andrew Reinhardt is *BYTE's* West Coast bureau chief. You can contact him on BIX as "areinhardt."

WINDOWS DEBUGGERS DO C++.

Toggle Decimal/Hexadecimal Display of Variable Value

Browse Pointer to Struct as Array of Structs

Enable C++ Class Name Display

Toggle Breakpoint

Set Breakpoint

Clear all Breakpoints

Step into Call

Step over Call

Go until Breakpoint

Find Next

Browse C++ Class Hierarchy

CommandBar

Restart Application

Open Source File (wild cards allowed)

Find Function (wild cards allowed)

Find String

Find Variable (wild cards allowed)

Source Window

Application C++ Classes

Application C++ Objects and Data Structure Window

Application Output

Debugging Log

Memory Contents

Assembly Decode

CPU/Coprocessor Registers

Application Functions

Debugger Help

Application Breakpoints

386/486 Watchpoints

Stack Call Chain Window

Application Files Window

C++ Class Hierarchy Browser

Window Message Spy

Graphical Representation of Data Structures and Objects

Only MultiScope 2.0 has what it takes to nail the bugs in your code, whether in Borland® C++ 3.0 or 3.1; Microsoft® C/C++ 7.0; or Microsoft® C 6.0.

When it comes to true C++ debugging, there's only one way to go — directly to MultiScope Debuggers Version 2.0. That's because only MultiScope can offer you real C++ debugging in a Windows environment today.

It's The Real C++ Thing — MultiScope.

As the only Windows-hosted debugger on the market today, MultiScope 2.0 delivers powerful features you won't find elsewhere.

PLUS, MultiScope C debugging features include the capability of browsing pointers to structures as arrays by simply

double-clicking on the desired array index, and the ability to browse any variable as if it was declared in any other type by simply using the sticky type transfer command.

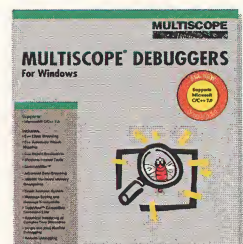
Real Power Is In Sight.

More importantly, it's all there at your fingertips. The MultiScope screen you see here tells the whole story; it's a powerful, feature-rich, integrated Windows environment, where the capabilities you need are just a mouse-click away.

A Real Value

In addition to real C++ debugging, the new MultiScope Debuggers 2.0 offer you real value. The MultiScope Debuggers for Windows provide the Windows Run-Time Debugger, MED, the Crash Analyzer System and more — all in one package.

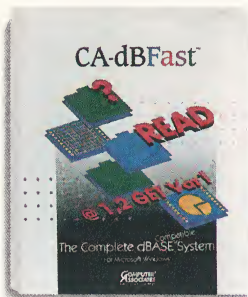
Act now! MultiScope retails for \$379. To get corporate pricing, or additional information call 1-800-999-8846 or 1-408-252-1652. To order direct, please call: 1-800-228-4122 x 8354. We even offer a 60-day money-back guarantee.



INCLUDING:

- A point-and-shoot C++ class hierarchy browser
- C++ object browsing
- Automatic C++ object mapping for all C++ inheritance types
- An alternative C++ class information display for clarity of member scope
- Windows-hosted debugging of Windows applications on the same screen
- A CodeView compatible command line
- A fully integrated SPY utility for spying multiple windows at the same time
- 386/486 hardware memory breakpoints for quickly finding memory overwrites
- Object-oriented breakpoints

Attention All dBASE Users: Your Windows Have Arrived.

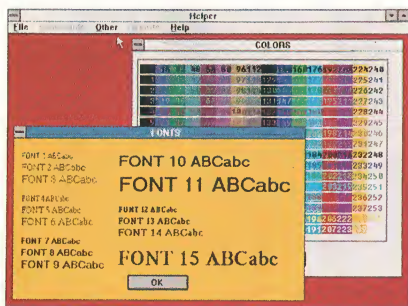


Introducing new CA-dBFast™. The first and only dBASE™ compatible database and

dBASE/X-Base language for Windows. It's the fastest, smartest and easiest way for millions of users and developers to join the Windows revolution.



Graphical, colorful CA-dBFast will bring new life to all of your

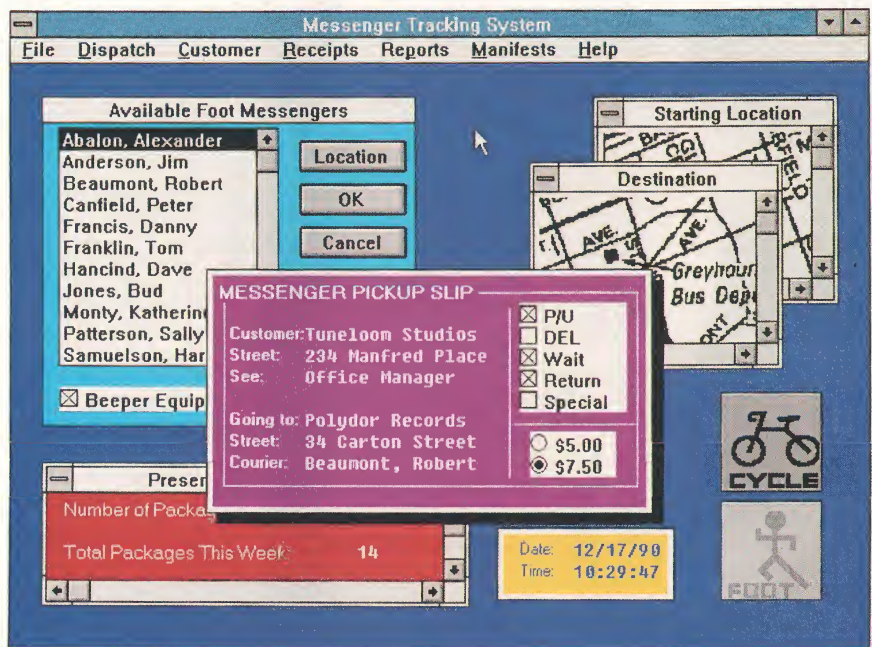


Your applications will really come to life with multiple colors and fonts.

existing dBASE programs.

Liven them up with multiple, movable windows, pull-down menus, check boxes, dialog boxes, radio buttons, push buttons and bitmap pictures.

CA-dBFast also helps you create new dBASE



CA-dBFast helps you create powerful, graphical database applications quickly and easily with pull-down menus, check boxes, radio buttons and even bitmap images.

programs quickly and easily.

Unlike other Windows development systems that force you to learn a new language, CA-dBFast allows dBASE, Fox and Clipper developers to use the language they already know with more than 200 extensions and an interactive editor, compiler and linker.



And full industry standard DDE and DLL protocols allow your programs to communicate with other

Windows applications.

So call 1-800-CALL CAI and we'll rush you a free Demo Disk.

Call right now. After all, haven't you waited long enough?

COMPUTER ASSOCIATES
Software superior by design.



BEST PRICE/PERFORMANCE

CA-dBFast™

Smile for the Computer

Digitally produced photos allow for quick output
and distribution with near-film quality

PHILIP CHIEN

A camera is a camera is a camera. Right? Wrong. With the rapidly approaching acceptance and implementation of digital photography, a camera isn't just a camera anymore. Used in combination with computers, digital photography has become a hybrid environment that makes the best use of both technologies.

You can use many methods to convert a real-life image into its digital counterpart. You can create digital bit-map images by using video digitizer frame-grabber boards that accept composite video signals and by using hand-held, flatbed, and slide scanners.

Of course, you can still produce superior-quality images using conventional silver-halide film rather than digital methods. For many applications, however, digital images resemble film images so closely that differences aren't noticeable.

Practical Applications and Advantages

Digital cameras can produce and transmit pictures quickly. News services can use digital cameras to take photos in the field and transmit the data by modem to central locations for immediate distribution to their customers. With a digital camera, the speed of distributing still photos is close to the speed of a live TV broadcast, but the quality is much better—as good or better than that of conventional film photos transmitted over news wires.

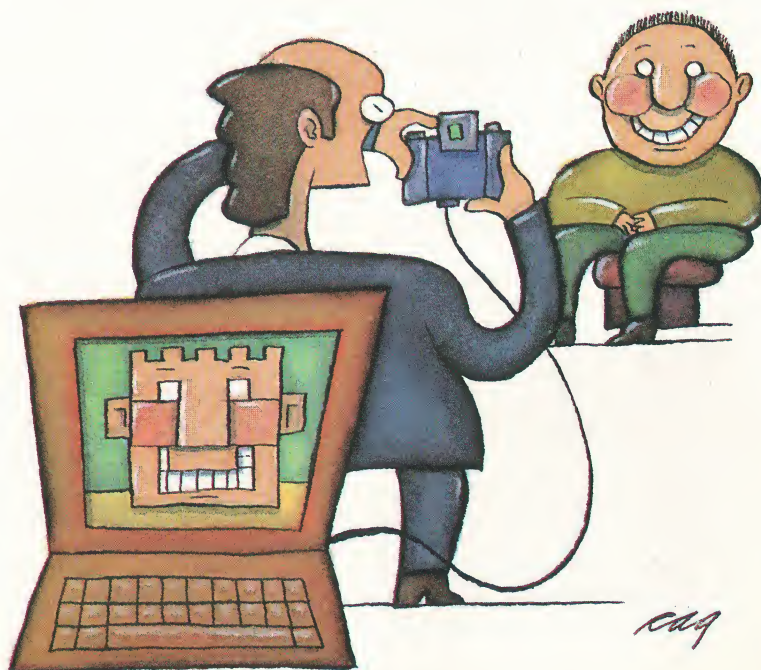
For computer users, probably the most important advantage to using digital images is being able to put images into desktop publishing documents. I've used digital images to good effect in various ways; for example, I've inserted photographs of company executives into newsletters, diagrams into technical manuals, product photographs into sales brochures, and documentation photography into viewgraph presentations. If you want to add an image to your document, you can do so quickly.

Digital images are also well suited for devel-

oping an image library. You can use large hard drives, WORM optical drives, and other mass-storage devices to store huge quantities of high-quality images. If you properly index the images, you can access a digital library quicker than you can a collection of photographs. Digital imaging is also better for the environment than conventional photography in that the technology eliminates the need for developer chemicals.

Kodak (Rochester, NY) offers its PhotoCD service to develop your slide film and, for an additional fee, scan the slides and save them onto a CD-ROM. Presently, PhotoCDs are not compatible with current CD drives.

Digital photographs can be distributed less expensively and more quickly than film or photographs. You can transmit



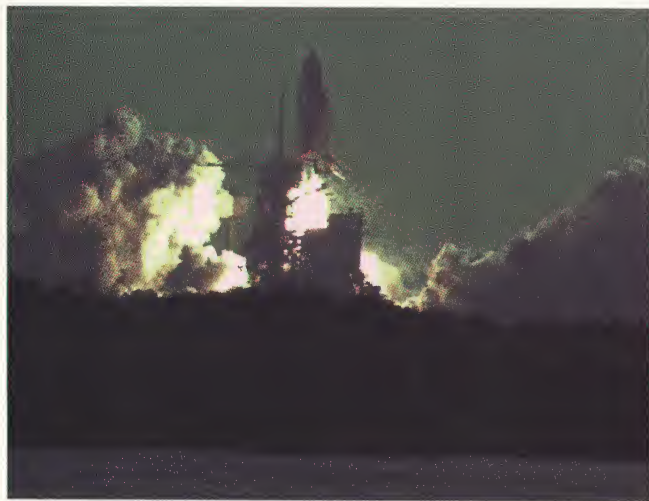


Photo 1: This photo of the March 24 launch of the space shuttle Atlantis on the STS-45 mission was taken with a digital camera and transmitted by modem to BYTE. It was then sent directly to the typesetter and printer without any hard copy ever being produced. (Photo courtesy of Philip Chien, Earth News)

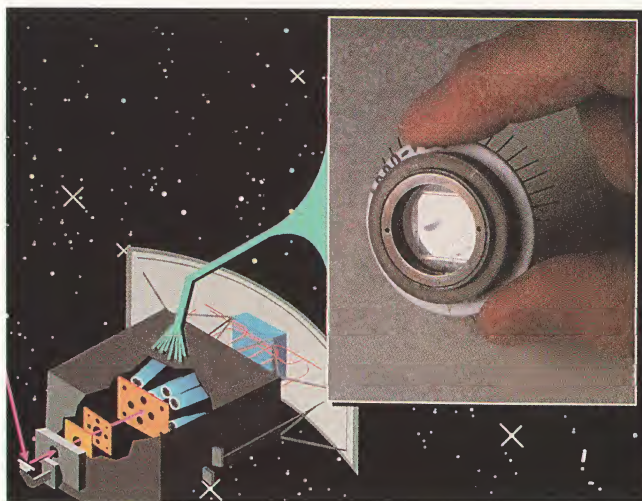


Photo 2: Each of the Hubble Space Telescope's WF/PC's four thumbnail-size CCDs has 800 by 800 pixels with 12-bit resolution (4096 gray levels). The WF/PC has 48 filters to examine different kinds of chemical compositions and is sensitive in the near-infrared, visible, and UV wavelengths. (Photo courtesy of Texas Instruments)

digital photographs by modem to individual locations or mass-distribute them via broadcast techniques. You can upload pictures to electronic BBSes and time-sharing systems, or even use a satellite broadcast to transmit high-quality images around the world. Also, the disks that you mail require less in-transit protection (and less postage) than photographs.

I used a digital camera, the Kodak DCS (Digital Camera System), to take pictures of a space-shuttle launch (see photo 1). I transmitted the picture by modem to a friend with a ham radio setup, who uplinked it to UoSAT-F, an amateur radio satellite in a polar orbit. Within hours, the satellite's flight path took it around the earth, and anyone with the proper hardware could download the picture.

Some people are concerned that digital cameras will eliminate the existence of photographic evidence, fearing that edited digital photographs could be passed off as original photographs. You can edit digital photographs to produce supermarket tabloid-style photos. But you can always determine that a photo was taken with a digital camera by magnifying the photo enough to show its square-pixel patterns. Conventional photos, as well as electronic text, have always been subject to "post-editing," and digital images aren't any different.

Collecting Images Digitally

Two types of cameras that use CCDs (charge-coupled devices) to collect images are *still-video* and *true digital*. Each has its own advantages and disadvantages.

True digital cameras are hybrids combining a film camera's optics with a computer's microprocessors. A digital camera's lens focuses the image on a CCD instead of on a roll of film. CCDs used in image applications are semiconductors arranged as a grid of microscopic light-sensitive detectors. Photo 2 shows CCDs that are extremely popular for aerospace applications. (See the text box "Digital Images from Space" on page 144.)

The CCD is the input for a fairly simple

computer consisting of a microprocessor, memory, multiplexing circuits, and a power source. The images can be stored in the camera's memory or onto a more permanent storage device, such as a floppy or hard disk (see the figure).

Shutters are optional for digital cameras. A high-quality, accurate shutter is usually one of the most expensive parts of a good camera. For some applications, you can build a digital camera less expensively simply by eliminating the mechanical shutter. In cameras without shutters, the software acts as the shutter, accepting only the light falls on the CCD within a designated time. CCDs don't react to light as quickly as film, and for certain high-speed applications, a shutter may be necessary.

Once the image is stored in the camera's memory, you can use several methods to transfer it to a computer. You can connect a cable from the camera to the computer's serial, parallel, or SCSI port; transfer a removable hard drive from the camera to the computer; or outfit the camera with a standard floppy drive.

Still-Video Cameras

The first commercial cameras to use CCDs were still-video cameras, two examples of which are the Canon Xapshot and the Sony Pro Mavica. These cameras use nonstandard 2-inch floppy disks that store data in analog format; for this reason, these disks don't actually qualify as digital media.

Still-video cameras aren't true digital cameras. You can view images from still-video cameras on video monitors or output them on hard copy by using specialized video printers. To convert still-video images into true digital format, you need an additional video digitizer board to convert the video image into actual computer data. Digital Vision (Dedham, MA) sells a still-video camera as an option for its ComputerEyes boards.

Still-video cameras are limited to TV resolution—less than 500 scan lines. A

Reasons to Use Digital Photography

- Insert photos in documents
- Electronically transmit photographs
- Mail images on disk
- Create an image library
- Easily edit photo images

IMAGINE BROWSING THROUGH THE LIBRARY OF CONGRESS AT 1500 MPH.

That's how quick the world's fastest CD-ROM drive moves you through volumes of information.

The new Pioneer DRM-604X Minichanger is **TWICE AS FAST** as any drive on the market. It has a data transfer rate **FOUR TIMES** the normal speed. And it holds **SIX** discs at once — more than any other drive.

High speed data transfer rate is an astounding 600 KBytes/sec. High speed access time averages 300 msec.

Change time between discs has been reduced from seven to five seconds.

If six discs are not enough, you can daisy-

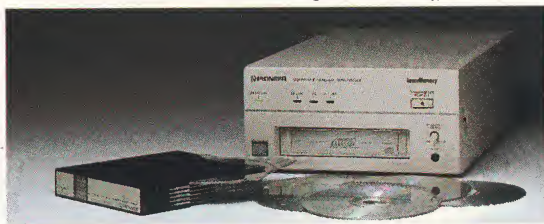
chain up to seven Minichangers from a single controller, giving access to 42 discs — more than 5 million pages of data.

The greatest amount of information at the greatest speed. It makes so much sense, it's hard to imagine why anyone would even consider any other drive.

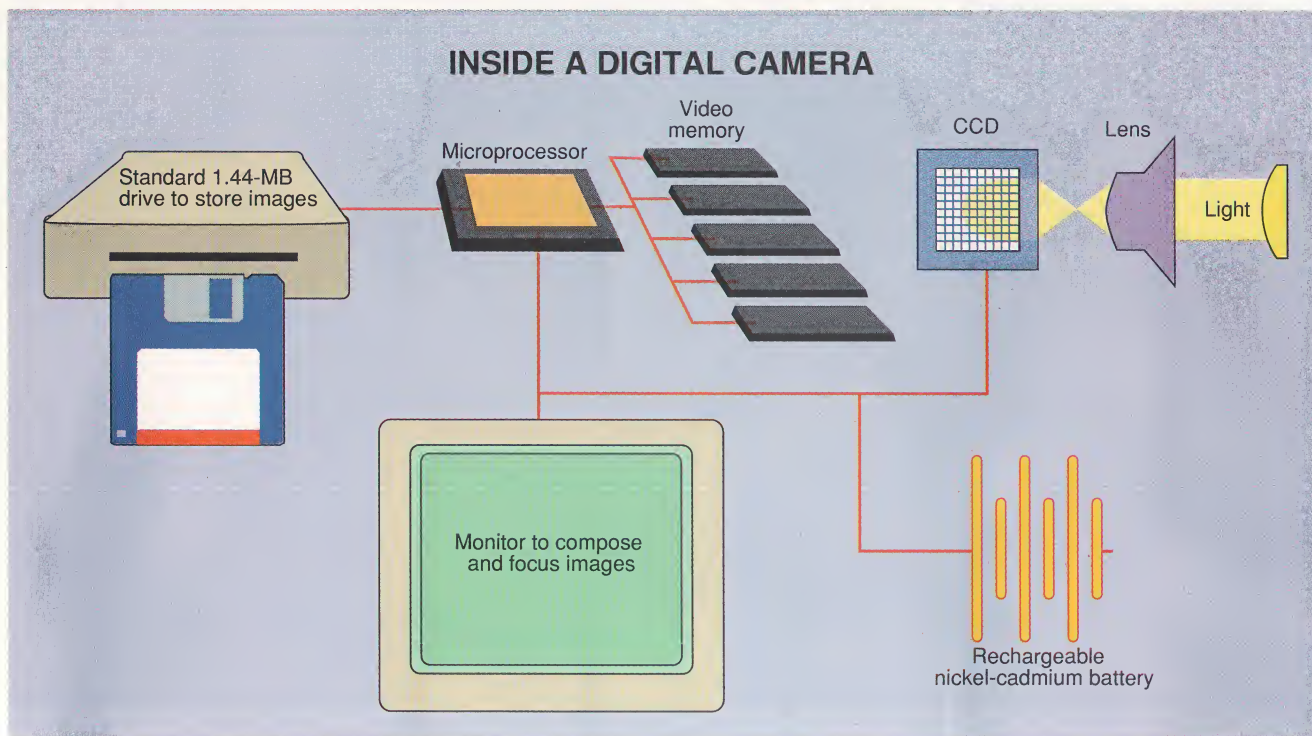
For more information, call 1-800-LASER-ON today.

Or write to Pioneer Communications of America, Inc., Optical Memory

Systems Division, 3255-1 Scott Blvd., Suite 103, Santa Clara, CA 95054.



**THE PIONEER HIGH SPEED
CD-ROM MINICHANGER**



A digital camera uses a CCD to convert images into electronic pulses. In this example, a standard 1.44-MB drive is used to store the images. Alternatively, you could use a serial cable to transfer the pictures from your camera to the computer.

still-video image is similar in quality to an extremely grainy newspaper picture.

True Digital Cameras

The resolution of true digital cameras is limited only by the density of the light-sensitive pixels on the CCD and practical memory constraints. Presently, true digital cameras are either extremely expensive or extremely unsophisticated.

FILM, STILL-VIDEO, AND TRUE DIGITAL IMAGES

Film, still-video, and true digital images each have their own advantages and limitations.

	Film	Still-video	True digital
Hardware cost	Low	Medium	High
Per-shot cost ¹	High	Medium	Low
Speed ²	Slow	Fast	Fast
Quality ³	Excellent	Poor	Good/ Very good
Ease with desktop publishing	Poor	Poor	Excellent
Duplication cost	High	Medium	Low
Duplication speed	Slow	Fast	Fast
Ease of use	Easy	Easy	Difficult
Transmittable via modem?	No	No	Yes

¹ Film and developing.

² The time from when the photograph is taken until the picture is produced.

³ Resolution and colors.

The least expensive and most practical method of creating still digital images is to take high-quality photographs and use a good flatbed scanner to digitize them. However, as true digital cameras become less expensive and the technology matures, you will find that the cameras provide several advantages.

I have experimented with two drastically different digital cameras—the \$799 10-ounce Logitech Fotoman and the \$20,000 19-pound Kodak DCS. The Logitech is the “Instamatic” of digital cameras. It is fairly lightweight but has very low resolution. The Kodak DCS produces excellent-quality images, but it’s extremely complicated to use. (Kodak recently introduced a newer model—the Kodak DCS 200ci—that sells for less than \$10,000.)

Right now, true digital cameras appear to be as unsophisticated as the earliest mid-1970s microcomputers: They have plenty of potential for future applications, but they are impractical for most uses. The table shows the qualitative differences between film, still-video, and true digital cameras.

Selecting a Digital Camera

Your most important criterion for choosing a digital camera is whether you need color. Monochrome cameras are capable of producing finer resolutions, and they work better in less light. If your primary application is using black-and-white images, you can use a typical office laser printer to create excellent-quality outputs. Color CCD cameras can produce fairly accurate color images on well-tuned RGB monitors, but only very high-end color printers can reproduce accurate colors.

Using a digital camera, you have the dual advantages of portability and immediate results. Unlike with film cameras, with a digital camera you can see exactly how your image will come out and make adjustments for composition and exposure on the spot. Advertisements for digital and still-video cameras suggest they can be effectively used in applications such as those performed by

A Computer is a Terrible Thing to Waste!

Learn More NOW with these Computer Books...



DR DOS 6.0 Complete

The user's guide to running DR's new DR DOS 6.0 operating system. From introduction to the basics to using and understanding DR DOS 6.0, learn to optimize your DR DOS system to your needs.

#B144. ISBN 1-55755-144-8. \$34.95 with 3.5" companion diskette. 800+ pages.

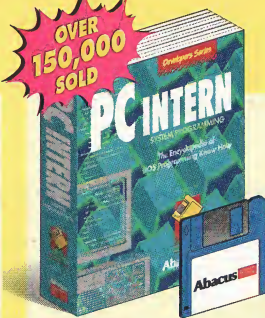


DOS 5.0 Complete Special Edition

Learn the 'ins and outs' of the new DOS 5.0.

- Using the new SHELL, EDIT, DOS-KEY, and QBasic
- Complete comprehensive DOS command reference section
- Includes Tempest software – the graphic shell for DOS 5.0

#B151. ISBN 1-55755-151-X. \$39.95 with Tempest and utilities diskette. 900 pages.

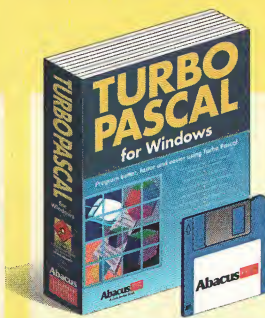


PC Intern

The encyclopedia of DOS programming know how for the professional programmer. Includes parallel working examples in ML, C, Pascal and BASIC.

- DOS and BIOS internal structures and functions
- Programming video cards, sound, TSRs

#B145. ISBN 1-55755-145-6. \$59.95 with over 2mb of source code on one diskette. 1300 pages.



Turbo Pascal for Windows

Introduction to the standard elements of Turbo Pascal.

- Development of the WinCrt, WinCrt and WinDOS units
- Comprehensive coverage of the Object Oriented Programming (OOP) features

#B141. ISBN 1-55755-141-3. \$39.95 with 3.5" companion diskette. 950 pages.



Turbo C++ Step by Step

Teaches you step by step C++, the language of choice among professional developers.

The lessons are designed to be short, progressive and to the point, so you can learn quickly.

#B156. ISBN 1-55755-156-1. \$34.95 with 3.5" companion diskette. 300 pages.



The 486 Book

Explains the features that make this processor so advantageous – the memory capabilities, the math coprocessor, the specialized software that maximizes the CPU's performance and more. PC INFO program on companion diskette.

#B155. ISBN 1-55755-155-3. \$34.95 with 3.5" companion diskette. 420 pages.



Windows 3.1 Intern

Introduces the reader to the overall concept of Windows programming and events using dozens of easy-to-follow examples. It's a solid guide for beginning to intermediate Windows programmers who need to know more, faster.

#B159. ISBN 1-55755-159-6. \$49.95 with 3.5" companion diskette. 1200+ pages.



Windows 3.1 Complete

Learn to optimize & customize Windows 3.1.

- Improve your productivity with built-in Windows applications
- Includes dozens of useful tips and techniques
- Includes two valuable Windows utilities: Backup & Snapshot

#B153. ISBN 1-55755-153-7. \$34.95 w/Windows utilities disk. 875+ pages.



OS/2 2.0 Complete

From installation, to overview, to the basics of the Presentation Manager, you'll learn how to take full advantage of this new operating environment.

#B157. ISBN 1-55755-157-X. Suggested retail price \$24.95.

Stepping Up To OS/2 2.0
The upgrader's guide to learning OS/2 in a hurry.
#B160. ISBN 1-55755-160-X. Suggested retail price \$16.95.



Sound Blaster Book

This book gives you a guide to the Sound Blaster from installation to custom programming. Includes an overview of the different Sound Blaster boards, many specific software products and much more. Also includes simple MIDI system to use with your Sound Blaster.

#B164. ISBN 1-55755-164-2. Suggested retail price \$34.95 with 3.5" companion diskette.

**Come See Us At Comdex Fall '92
We'll Be At Booth #102**

Available at B. Dalton Booksellers, CompUSA, Crown Books, Software etc., WaldenSoftware, Computer City, and other retailers nationwide. In the UK call Computer Bookshops 021-706-1188. In Australia call Pacronics 02-748-4700.

Abacus
Dept. B11, 5370 52nd Street SE, Grand Rapids, MI 49512
Phone: (616) 698-0330 • Fax: (616) 698-0325

**Order Toll Free
1-800-451-4319**

In US and Canada add \$5.00 postage.
Foreign orders add \$13.00 postage per item. We accept Visa, Mastercard or American Express.

Please rush me the following books:

DR DOS 6.0 Complete \$34.95 ea.
DOS 5.0 Complete S.E. \$39.95 ea.
PC Intern \$59.95 ea.
Turbo Pascal for Windows \$39.95 ea.
Turbo C++ Step by Step \$34.95 ea.
The 486 Book \$34.95 ea.
Windows 3.1 Intern \$49.95 ea.
Windows 3.1 Complete \$34.95 ea.
OS/2 2.0 Complete \$24.95 ea.
Stepping Up To OS/2 2.0 \$16.95 ea.
Sound Blaster Book \$34.95 ea.

Subtotal:

CA & MI orders include correct sales tax:

In US & Canada add \$5.00 shipping:

Foreign orders add \$13.00 per item:

Total amount (US funds):

For fast delivery Order Toll Free 1-800-451-4319 EXT. 211, or FAX (616) 698-0325

Or mail this coupon to: Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512

Method of Payment: ☐ Visa ☐ Master Card ☐ Am. Express ☐ Check / M.O.

Card#: _____ Expires: ____/____/____

Name: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone#: _____ Fax#: _____

☐ Yes, please rush your free catalog of PC books and software.

Dept. B11

Digital Images from Space

Most digital images are created with CCDs (charge-coupled devices), tiny detectors in a grid pattern residing on a silicon chip. In 1969, Bell Labs (Holmdell, NJ) developed CCDs, but they did not become popular until engineers found they could be used in various aerospace applications. CCDs are lighter, use less power, and are more efficient than photographic film or video tubes—all important features for spacecraft components.

An early CCD application was the Hubble Space Telescope's Wide Field/Planetary Camera, or WF/PC (pronounced "wiff-pic"). Each thumbnail-size CCD has an 800- by 800-pixel matrix capable of distinguishing 4096 gray levels (i.e., 12 bits). The four images can be electronically combined to create a 1600- by 1600-pixel picture. WF/PC operates like a zoom lens: In its wide-field mode, it can take images of relatively large areas, and in its planetary-camera mode, it can zoom in for close-up views of planets. Some of its results include incredible images of planets, galaxies, globular clusters, and nebulae (see photo A).

Other scientific satellites that use CCDs include the European Giotto, which returned the first close-up pictures of Halley's comet, and the U.S./German Galileo spacecraft, which is en route to Jupiter. Closer to Earth,



Photo A: The Hubble Space Telescope's WF/PC took this picture of Saturn in its wide-field mode. The image is the equivalent of observing Saturn with the naked eye at a distance of 500,000 miles. Virtually all the image's spherical aberration has been removed using computer deconvolution techniques. (Photo courtesy of Space Telescope Science Institute, NASA)

thousands of home and professional video cameras use CCDs. In an interesting reverse-technology transfer, dozens of space-shuttle missions have carried along home camcorders. A handful of missions have carried a modified 35mm camera with a CCD.

The Electronic Still Camera

The Electronic Still Camera, built by NASA, uses the optics from a Nikon F4. Engineers at the Johnson Space Center (Houston, TX) installed a 1024- by 1024-pixel, 8-bit (256-light-level) CCD at the film plane. Other modifications included a microprocessor controller and a 42-MB removable hard drive "film cartridge." Since the ESC uses a standard F4 body, it can use normal Nikon accessories (i.e., lenses and a flash).

The ESC setup includes an MS-DOS

laptop computer with two expansion slots: an adapter to transfer the data from the hard drive film cartridges, and a video board to display images on the shuttle's on-board video monitors. On some missions, the astronauts have the capability to downlink images to the control center through the shuttle's high-bandwidth (Ku-Band) data channel.

The data is received on a workstation where it is displayed and archived. On Spacelab missions, where the experiments have the highest priority for data transmissions, the ESC stores its pictures on the hard drive film cartridges

for analysis after the space shuttle returns.

The ESC was carried on the STS-48 mission, which deployed an Earth observation satellite; the STS-42 IML-1 (International Microgravity Laboratory) mission; the STS-45 ATLAS-1 (Atmospheric Laboratory for Applied Sciences) mission; and the STS-49 mission, which rescued a stranded Intelsat satellite. Engineers and astronauts who have used the ESC are extremely happy with the results, and upcoming flight crews have requested that the camera be added to their missions.

ESC's downlink capabilities would be extremely useful on future long flights. Other versions under development include enhanced features such as higher resolution, color, and low-light capabilities.

instant cameras (e.g., real estate sales, medicine, R&D, and insurance claims). Besides current applications where digital cameras have marginal advantages, post-processing digital techniques will offer new benefits.

Even though true digital cameras have some inherent limitations, once you get used to using them, you'll discover the added flexibility of being able to store images on magnetic media. Being able to see a preview image on the camera's built-in monitor assured me that I would obtain the results I wanted. I discovered that I was much more comfortable taking several images at different exposures and settings, because I could easily delete

pictures that didn't come out well.

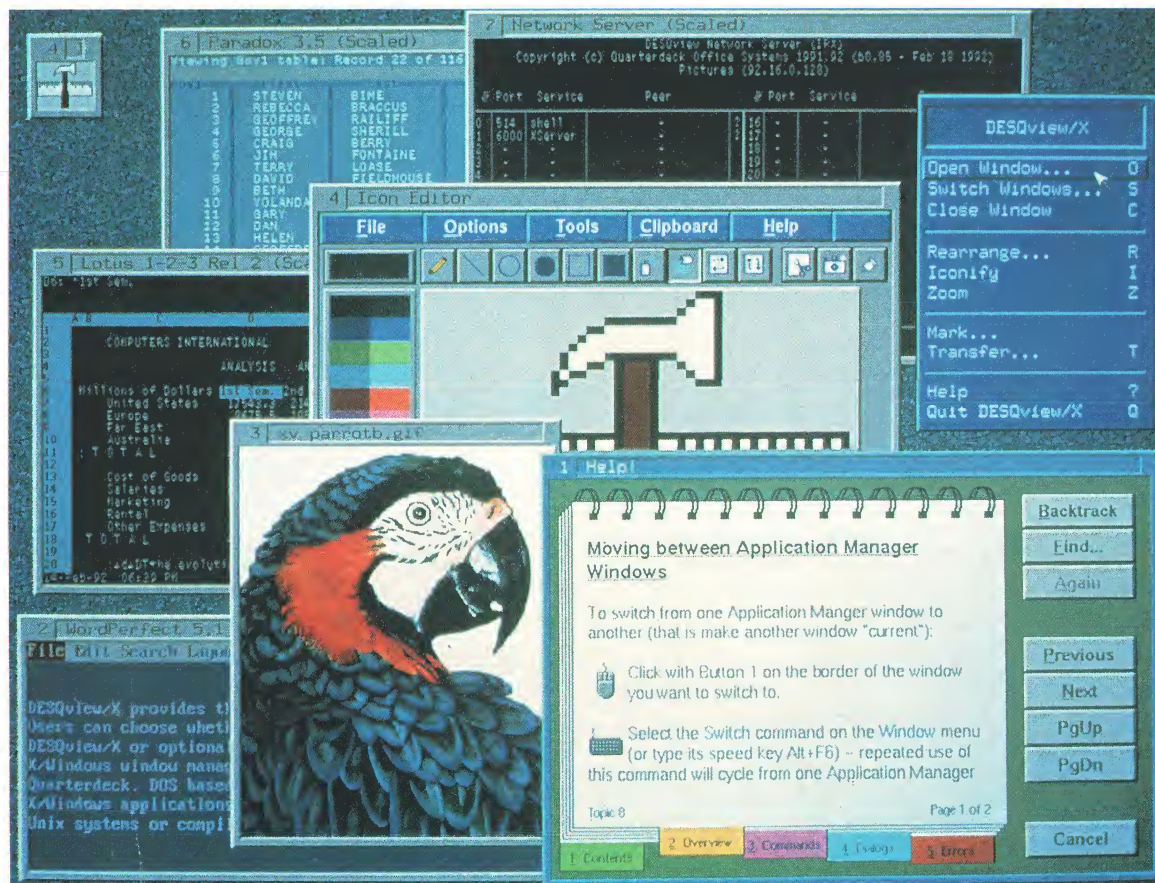
Desktop publishing has allowed people to become their own publishers and printers. Digital image processing will extend conventional printing technologies and offers the potential to improve the quality and feel of images even further. ■

Philip Chien is an aerospace and microcomputer consultant. He started in the microcomputer field working with the original 1977 Apple II, and, since 1983, he has covered and written about computers and the U.S. space program. You can reach him on BIX c/o "editors."

DESQview/X™

Quarterdeck

A Technical Perspective For the '90s



A Technical Perspective For the '90s

1	Introduction	QD-3	4	DESQview/X	QD-17
2	DESQview and PC Fundamentals	QD-5	4.1	Minimum Requirements	QD-17
2.1	Introduction	QD-5	4.2	General Structure	QD-17
2.2	The PC Memory Map	QD-5	4.2.1	The X Server	QD-17
2.2.1	Conventional Memory	QD-5	4.2.2	Socket Driver	QD-17
2.2.2	Extended Memory	QD-5	4.2.3	Regular DOS Applications	QD-17
2.2.3	Expanded Memory	QD-5	4.2.4	DESQview API Applications	QD-17
2.3	EMS 3.2	QD-5	4.2.5	Microsoft Windows and Windows Applications	QD-18
2.4	EEMS and EMS 4.0	QD-5	4.2.6	Regular DOS Graphical Applications	QD-18
2.5	Software Emulation of EMS memory	QD-6	4.2.7	X Clients	QD-18
2.6	Multitasking more than 640K	QD-6	4.3	Direct Windows	QD-18
2.7	LOADHI capability	QD-6	4.4	Available Memory	QD-18
2.8	Program Swapping	QD-6	4.5	The Window Manager	QD-18
2.9	Switching and Windowing	QD-6	4.6	Fonts	QD-18
2.10	Application Video Behavior	QD-6	4.6.1	Scalable Fonts	QD-18
2.10.1	Well-Behaved Applications	QD-6	4.6.2	Using Scalable Fonts	QD-19
2.10.2	Ill-Behaved Applications	QD-6	4.6.3	Scalable DOS Windows	QD-19
2.10.3	Virtualization	QD-7	4.7	Advanced Memory Management	QD-20
2.10.4	Loaders	QD-7	4.7.1	Virtual Memory	QD-20
2.11	Microsoft Windows	QD-7	4.7.2	Dynamic Link Libraries	QD-20
2.12	Application Types	QD-7	4.8	Print Server	QD-21
2.13	DESQview API	QD-7	4.8.1	DOS Application Printing	QD-21
2.13.1	The SHADOW Call	QD-7	4.8.2	X Client Printing	QD-21
2.14	Processor Types and Modes	QD-8	4.8.3	Print Manager	QD-22
2.14.1	The 8088/8086 and Real Mode	QD-8	4.9	The Network Connection	QD-22
2.14.2	The 286 and Protected Mode	QD-8	4.9.1	The Network Manager	QD-22
2.14.3	The 386 and V8086 Mode	QD-9	4.9.2	Operation over a Network	QD-22
2.14.4	The 486	QD-9	4.9.3	Communication Ports	QD-23
2.15	DOS Extenders	QD-9	4.9.4	Remote Shell	QD-23
2.16	VCPI Specification	QD-10	4.9.5	Remote Exec	QD-23
2.17	DESQview Capabilities	QD-10	4.9.6	File Transfer Protocol	QD-24
3	An Introduction to X	QD-11	4.9.7	Telnet	QD-24
3.1	Traditional Graphics Output	QD-11	4.9.8	Remote Clients	QD-24
3.2	X Servers, Clients and Protocol	QD-11	4.9.9	Interprocess Communications	QD-24
3.3	An Event-Driven System	QD-11	4.10	Stand-Alone or Networked?	QD-24
3.4	A Distributed System	QD-12	4.10.1	Unix Machines and DOS/Microsoft Windows programs	QD-24
3.5	Operating System and Architecture Independence	QD-12	4.10.2	DOS Machines and Unix Programs	QD-25
3.6	X Terminals	QD-12	4.11	A User's View	QD-25
3.7	A Stand-Alone System	QD-12	4.12	A Consistent Growth Path	QD-25
3.8	The Window Manager	QD-12	4.13	DESQview/X System Capabilities	QD-25
3.9	X Development Layers	QD-13	5	Development Issues	QD-27
3.9.1	Xlib	QD-13	5.1	Real Mode Applications Development	QD-27
3.9.2	Toolkits	QD-13	5.2	Protected Mode Applications Development	QD-27
3.9.3	Intrinsics and Widgets	QD-15	5.2.1	Using a Protected Mode Compiler and Linker	QD-27
3.9.4	Xt Intrinsics	QD-15	5.2.2	Using a Regular DOS Compiler	QD-27
3.10	X11	QD-15	5.2.3	DOS Extenders	QD-28
3.11	Toolkit Summary	QD-15	5.3	X Client Development for DESQview/X	QD-28
			5.3.1	DESQview/X Development Kits	QD-28
			5.3.2	DOS/4GX Support	QD-28
			6	DESQview/X Products	QD-29

1 Introduction

This document is intended to provide end users and developers with an understanding of the capabilities and implementation of the DESQview/X product, along with the DESQview DOS multitasker and the X Window System.

Definitions

X Window System

The X Window System is a hardware-independent and operating system-independent graphics standard designed to operate over a network or within a stand-alone machine. Developed at the Massachusetts Institute of Technology in 1984, it has subsequently become an industry standard employed by companies such as AT&T, DEC, Hewlett-Packard, IBM, Sun Microsystems and others.

X Server

An X Server is a special X Window System graphics application that controls a computer's display screen, drawing windows, text, lines, pictures, circles, polygons and the like according to the requests (messages) from an application. An X Server may handle the screen drawing for multiple applications concurrently - each application typically displaying information with one or more windows on the screen.

X Client

An X Window System application program (such as a spreadsheet or drawing program) that communicates with an X Server is called an X Client. A well-defined messaging system links the two participants. This messaging system may occur over a network or within a single machine.

DESQview/X:

- Is a third DESQview (DESQview, DESQview 386 and now DESQview/X), adding distributed graphics and remote computing capabilities to Quarterdeck's multitasking DOS environment.
- Brings the X Window System to DOS — thereby enabling DOS users to participate in the many graphical and multimedia advances available today only on workstation platforms.
- Allows DOS PCs to participate in industry standard, multivendor, multi-operating system, distributed processing (cross-platform computing).
- Supports the latest advancements in font technologies and advanced memory management.
- Provides printer spooling for DOS PCs as well as remote printing capabilities for Unix X Window workstations and other DOS PCs.
- Gives users of Unix X Window workstations access to many off-the-shelf DOS and Microsoft Windows software packages.
- Gives DOS users access to Unix X Window workstations or mainframe programs (Clients).
- Gives DOS users access to Unix text-based applications (using xterm).
- Gives DOS users access to more powerful DOS and Microsoft Windows programs that are not capable of being run on their own machine.
- Promotes DOS to that of a multiuser system through its remote execution and security features.
- Provides file transfer capabilities between DOS and Unix or other DOS machines on a network.
- Provides developers with an industry standard "open", graphical development environment and choice of user interface.
- Supports industry standard methods for application programs to communicate across a network (Inter Process Communications), regardless of the network type.
- Provides X Client developers and manufacturers access to the huge installed base of DOS machines.

Specifically, it:

- Runs either stand-alone or as a networked system.
- Adds a graphical 3D look and feel to DESQview.
- Provides a growth path from character mode DOS to industry standard graphical user interfaces.
- Gives users a choice of interfaces (window managers) - the DESQview/X, OSF/Motif or OPEN LOOK interfaces are prime examples.
- Dynamically scales the windows of DOS text applications to any size (scalable DOS windows), from just a few pixels to full screen, using scalable font technology.
- Can run applications up to 16MB (16-bit protected mode) or 4GB (32-bit protected mode) by supporting the use of 16-bit and 32-bit DOS Extenders.
- Supports the use of virtual memory and dynamic link library technology to drastically reduce the amount of memory needed to run large application programs.
- Incorporates the Adobe Type Manager and scalable font technology giving X Clients access to the vast array of Adobe Type 1 fonts.
- Allows users to run many off-the-shelf DOS and Microsoft Windows applications in windows side-by-side with local or remote X Window Clients.
- Incorporates a Print Server that can handle print requests from remote machines (both DOS and Unix) connected on a network, while spooling to a printer.
- Allows local users to display and use many off-the-shelf DOS and Microsoft Windows applications that are running on another machine on a network.
- Allows local users to display and use Unix graphical applications (X Clients) that are running on another machine on a network.
- Allows local users to display and use Unix text-based applications that are running on another machine on a network (using the xterm program).
- Allows local users to display and use DOS Clients written for X (graphical applications) that are running on another machine on a network.
- Allows X Window Unix users to display and use many off-the-shelf DOS and Microsoft Windows applications that are running on another DOS machine on a network.
- Provides a multiple level security feature to restrict access to a machine by other remote machines.
- Implements the File Transfer Protocol (FTP) for the peer-to-peer transferring of files to remote machines (DOS or Unix).
- Gives developers a choice of application styles - OSF/Motif, OPEN LOOK and others - or the freedom to design their own.
- Implements a printer imaging model that mimics X Window System display output so that X Clients need only support a single imaging model for both display and printer output, greatly simplifying the coding of X Clients.
- Implements the Berkeley Socket interface, providing Inter Process Communications between separate applications (on the same machine or even across a network) that is independent of the underlying network type.
- Provides developers a platform to port X Clients from Unix to DOS.
- Allows developers to create X Clients in a DOS environment for later porting to other operating systems using the X Window System.

The purpose of this document is to explain how the features of DESQview/X are possible. It provides coverage of the DESQview DOS multitasker, the X Window System and the integration of both of these technologies. This document also describes the development processes necessary to create X Client graphical applications for DOS.

2 DESQview and PC Fundamentals

This section describes the fundamentals of the DESQview multitasking software and basic PC concepts. Readers familiar with these topics are still encouraged to read the information presented here.

2.1 Introduction

DESQview is a program that extends DOS (either PC-DOS, MS-DOS or DR DOS) into a fully pre-emptive multitasking system. Contrary to popular belief, DESQview can perform multitasking on *all* classes of processor - 8088, 8086 (PC-XT), 286 (PC-AT), 386 and 486. However, the technical advances of the later processors empower DESQview with greater capabilities.

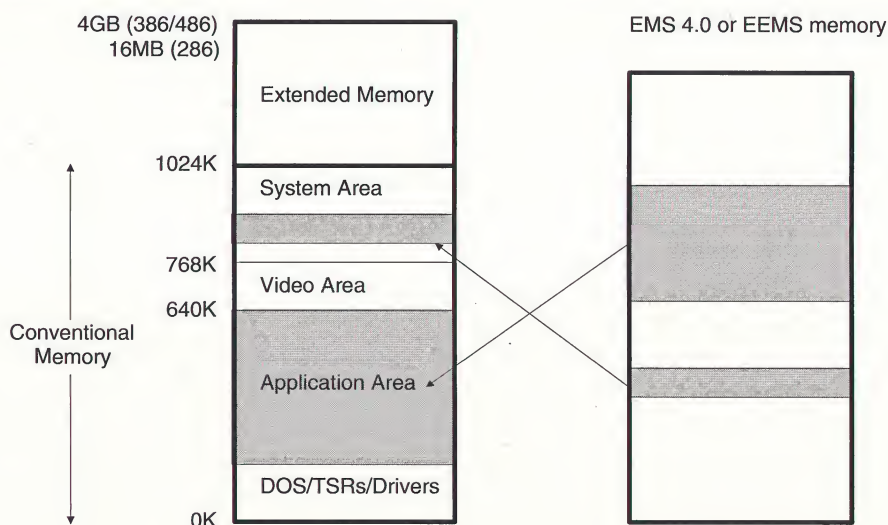
DESQview is compatible with most current PC software - and can even run Microsoft Windows 3.0, 3.1 along with Windows programs, GEM-based, as well as other graphic programs simultaneously.

A program in the DESQview environment may run occupying the whole display screen, or can appear in a small window, framed by a border. Multiple applications may appear on the screen simultaneously, each in its own window.

Certain applications may run in a small window and in "background", depending on how the program has been written and the type of processor being used - a table later in this section summarizes specific capabilities.

2.2 The PC Memory Map

A brief explanation of the architecture of a PC's memory map is beneficial to the understanding of this document. A PC's memory is laid out as follows:



2.2.1 Conventional Memory

Conventional Memory is memory that resides from 0K to 1024K (1MB). DOS, TSRs (Terminate and Stay Resident programs) and device drivers are loaded at the bottom of this memory with video RAM being located between 640K and 768K. Between the top of DOS and the bottom of video memory is the **Application Area**. Above the video area and below the top of conventional memory (1024K) is the **System Area** or what Quarterdeck refers to as High Memory. The System Area contains, for example, special system code such as the machine's BIOS (Basic Input/Output System) or RAM for a hardware card. Typically, this area is not contiguous, but contains portions of unused address space, sometimes more than 128K in size. See Quarterdeck's Manifest User Manual for a detailed description of High Memory (System Area).

2.2.2 Extended Memory

Extended Memory is memory that resides from 1MB and upwards (up to 16MB on a 286, 4 Gigabytes on a 386/486). It is available on machines that use a 286 processor or better and hence is not available on 8088/8086 machines. To be able to directly access this memory the processor must be in a special mode called **protected mode**. This mode is incompatible with DOS and DOS applications which run in **real mode**.

2.2.3 Expanded Memory

Expanded Memory is memory that acts as a "pool" of memory which, under the control of a special program (the **Expanded Memory Manager**), can be "mapped" into one or more conventional memory areas. **Mapping** is a process whereby a portion of expanded memory "appears" at a specific memory location through the use of special hardware (or in certain circumstances via software control - see the section titled "Software Emulation of EMS Memory"). Note that no transfer of data is actually performed - EMS memory is a bank-switch type of system (and hence very fast).

Unlike extended memory, expanded memory is available for all processor types. There are 3 different types of expanded memory, EMS 3.2, EEMS and EMS 4.0.

2.3 EMS 3.2

EMS 3.2 can only map four 16K pages of memory (64K) into conventional memory at a time, typically into a 64K area within the System Area called the **EMS Page Frame**. EMS 3.2 memory is essentially limited to enhancing the data handling capabilities of a program and has been superseded by the other two types of expanded memory.

2.4 EEMS and EMS 4.0

EEMS and **EMS 4.0** memory can map multiple pages of varying size into conventional memory enhancing both data access and program execution capabilities - a far more flexible scheme than EMS 3.2. Note, however, that some EMS 3.2 memory boards were packaged with a 4.0 Expanded Memory Manager. Unfortunately, this gives the user an impression that EMS 4.0 memory is available with these boards, when only 3.2 capabilities are.

Note that for the remainder of this document, all references to EMS 4.0 memory are also applicable to EEMS memory.

2.5 Software Emulation of EMS memory

Due to the capabilities of the 386 and 486 processors, an Expanded memory manager like Quarterdeck's QEMM-386 can "convert" extended memory into EMS 4.0 memory. In the case of programs like QEMM-386, it is the Expanded memory manager that provides the mapping function through software control.

2.6 Multitasking more than 640K

Despite DOS normally being limited to 640K for its programs, DESQview can run more than 640K concurrently by using expanded memory. Programs are loaded first into the Application Area and when this is exhausted, DESQview will load programs into EMS 4.0 memory. As DESQview task switches from one application to another, it first maps the application from EMS memory into the Application Area and then runs it.

Note that EMS 3.2 memory is not used in this way due to the limitations of the specification; EMS 3.2 memory can only map a maximum of 64K and hence the available partition size is too small to contain the majority of programs.

On 8088/86 and 286 based systems, it is essential to disable motherboard memory to as low a value as possible (typically 256K) when using EMS 4.0 memory and DESQview. Due to hardware limitations of these processors, EMS 4.0 memory cannot be mapped on top of other memory (RAM or ROM) that is present in the system. If motherboard memory cannot be disabled, DESQview cannot multitask applications in EMS 4.0 memory. In the worst case, EMS 4.0 memory can act like EMS 3.2 memory to store "swapped" programs (see the "Program Swapping" section for details), but may still have the LOADHI capability outlined next.

2.7 LOADHI capability

Since DESQview uses the Application Area below 640K to perform its multitasking "magic", it can be seen that the larger this area is, the larger applications can be that run under DESQview (unless an application is a DOS Extended application - see the "DOS Extender" section for details).

Any TSRs (Terminate and Stay Resident programs) or drivers (such as mouse or network drivers) that are loaded before DESQview occupy space in conventional memory on top of DOS and reduce the amount of memory available to the Application Area. It is therefore advisable to keep the number of TSRs and device drivers using conventional memory to a minimum to ensure a maximum amount of space for applications.

One solution is available with the Quarterdeck QRAM, QEMM-50/60 and QEMM-386 products - the **LOADHI** capability. With this utility, TSRs and device drivers can be loaded into the unused regions of the System Area, thus freeing up more space below 640K and enabling larger applications to be run inside of DESQview.

2.8 Program Swapping

When all of the Application Area and EMS 4.0 memory has been used to store programs, any further loading of applications will cause DESQview to swap applications already running onto either a hard disk, a network drive, a RAM drive or expanded memory (even EMS 3.2 can support this type of operation). Any programs "swapped out" in this way will be suspended from running. Despite being suspended, any swapped applications can be swapped back in at the request of the user with only a

short delay. Doing this will force one of the currently running programs to be swapped out in order to make room if there is not enough memory for the incoming program.

Note: DESQview/X version 1.0 does not support DOS program swapping.

2.9 Switching and Windowing

Since DESQview can multitask multiple DOS applications, a user can **switch** from one application to another using two or three keystrokes or mouse clicks. Because of this, there is a concept in DESQview of one foreground application and multiple background applications.

Some applications may be running in **windows** smaller than the screen size and others may occupy the whole screen. In addition, some applications may be running in background, while others are suspended. These capabilities are dependent on the video behavior of the program and the machine's processor type.

2.10 Application Video Behavior

DOS applications may be written to produce display output in either of two ways. They may call DOS and BIOS routines to perform the output, or alternatively may write directly into the video area. The latter method is usually employed for speed reasons. Applications that use the DOS and BIOS routines are termed **well-behaved** and others that write directly to the video area are **ill-behaved**. Typically, graphical applications are ill-behaved; text-based applications may be either.

2.10.1 Well-Behaved Applications

Since DESQview can easily intercept DOS and BIOS calls, well-behaved applications may run in a small window or in background on any machine regardless of processor type. When a well-behaved application makes a video BIOS or DOS call, DESQview intercepts and executes the call, but places the relevant information in a special save area called the **logical window buffer** as well as clipping and shifting the information to appear within a small window on the screen.

2.10.2 Ill-Behaved Applications

Since ill-behaved applications write directly to the video RAM, DESQview cannot run them in a small window or in background unless the processor is a 386 or a 486 (see the "Virtualization" section for details). These applications, when run on an 8088/86 or 286 PC, can only run full screen in the foreground. Application developers should note that in many cases it is very easy to make an ill-behaved text application well-behaved, simply by adding a single subroutine call - see "The SHADOW Call" section for details.

2.10.3 Virtualization

Due to the sophisticated memory handling capabilities of the 386 and 486 processors, DESQview can redirect an application that writes directly to video RAM to a portion of memory that DESQview calls the **logical window buffer**. DESQview copies the information from this buffer to the actual video RAM, clipping and shifting it as necessary to appear within a small window. In this way, DESQview coupled with QEMM-386 and a 386 or 486 processor can **virtualize** ill-behaved applications (including graphics ones) in small windows and run them in background.

The only exception to this process are graphical DOS Extended applications - see the "DOS Extenders" section for more information. This is because the virtualization process uses a special processor mode that is incompatible with the DOS Extender.

Note: Version 1.0 of DESQview/X does not support the virtualization of DOS graphics programs.

2.10.4 Loaders

For machines that do not have a minimum of a 386 processor, a loader may be available to run an ill-behaved text program in a small window and in background. **Loaders** are utilities that alter a program's operation while it is running and coerce it into being well-behaved. Quarterdeck supplies several loaders with DESQview for use with programs such as Lotus 123.

2.11 Microsoft Windows

Microsoft Windows (and any Windows applications running within it) appears to DESQview simply as a graphical application and is handled as such. Consequently, Windows 3.0 real mode can be virtualized in a small window on machines with 386/486 processors whereas Windows 3.0 and 3.1 standard mode runs full screen (Windows standard mode acts like a DOS Extended graphical application).

Presently, Windows 3.0 and 3.1 386 enhanced mode does not function under DESQview. Note, however, that some of the extra capabilities of 386 enhanced mode (such as the virtualization of DOS windows) are duplicated in DESQview and are best handled by DESQview.

Note: DESQview/X includes special Windows drivers that enables Windows 3.0 in real mode and Windows 3.0, 3.1 in standard mode to run in small windows and remotely.

2.12 Application Types

There are three types of applications that exist in the DESQview multitasking environment: DESQview-oblivious, DESQview-aware and DESQview-specific.

DESQview-oblivious	DESQview-oblivious programs are ones that know nothing about DESQview - this includes programs like Lotus 123, Microsoft Word or AutoCAD.
DESQview-aware	A DESQview-aware program is one that has been modified slightly to make it run more efficiently in DESQview. Paradox, dBASE and WordPerfect are examples of DESQview-aware programs.
DESQview-specific	A DESQview-specific program has been written to take advantage of the DESQview API (Application Program Interface). Consequently, these programs can only run when DESQview is present.

2.13 DESQview API

Present in every copy of DESQview is the **DESQview API** (Application Program Interface). This interface allows programs to call the DESQview subroutines and functions in order to start and close down other applications; move, resize and scroll their windows; perform intertask communication and many other functions. The DESQview API is callable by Assembler, C, BASIC, Pascal, Clipper and dBASE programs.

2.13.1 The SHADOW Call

One API call of particular significance is the **SHADOW** call. This call may be made whether DESQview is present or not.

An ill-behaved text application will typically determine the kind of system present (monochrome or color) and load a variable with the corresponding video RAM value for the system (either B000H or B800H). From then on, the application will use the variable in order to access video RAM.

If during initialization, a program performs the SHADOW call using the desired video RAM value before storing it, the program will then become well-behaved when running under DESQview. This is because DESQview returns the logical window buffer for that application, whereas under DOS, the SHADOW call returns the value unchanged.

Since the application stores the returned value and uses it whenever video RAM access is required, the application is writing directly into the DESQview logical window buffer instead of to the screen. DESQview **shadows** from the logical window buffer to the screen, clipping and shifting as necessary, so the otherwise ill-behaved text application can run in a small window and in background on all processor types. This process is fast enough to be rarely noticeable by the user. WordPerfect, Dbase and Paradox are examples of commercially available programs that do this.

2.14 Processor Types and Modes

Since the original PC was introduced in 1981, various processors have been used, each one superseding the previous version and providing greater functionality. This functionality was always gained with the advantage of backward compatibility with all the previous processors.

2.14.1 The 8088/8086 and Real Mode

When the PC was first introduced, it used an Intel 8088 microprocessor. This is a 16-bit architecture processor with a segmented memory scheme capable of addressing 1MB. The 8088 used an 8 bit external data path unlike its otherwise functionally equivalent bigger brother, the 8086 which used an external data path of 16 bits. The mode of operation of these two processors is termed **real mode**.

2.14.2 The 286 and Protected Mode

The 286 processor supplies a real mode capability, but improved upon the 8088/86 by providing a new mode called **protected mode**. In protected mode, the 286 can access up to 16MB of memory (again by using a segmented addressing scheme), however certain operations available in real mode (such as segment arithmetic) are prohibited in protected mode. In addition, protected mode also has the hardware necessary for an operating system to "protect" an application from crashing the system or overwriting another application.

Unfortunately, protected mode is sufficiently different from real mode that DOS and regular DOS applications cannot operate in protected mode. For a long time this limited applications to running in real mode and hence constrained them to the 1MB limit. Thankfully, a solution has become available that addresses this called the DOS Extender - see the "DOS Extenders" section for details.

2.14.3 The 386 and V8086 Mode

Next to be introduced was the 386. Providing backward compatibility means that the 386 has both a real mode and protected mode capability. But in addition to this, Intel added a third mode called **Virtual 8086 Mode** that can operate under the auspices of protected mode. This mode supplies a virtual 1MB 8086 style environment while running in protected mode. This elegant solution enables regular DOS and real mode applications to run under protected mode without modification. The 386 also has an effective addressing range of 4 Gigabytes. It supports a flat memory model as well as a segmented addressing mechanism.

Also included in the 386 were memory mapping capabilities, a 32-bit architecture and hooks for a paged virtual memory system as opposed to a somewhat meager segmented virtual memory system that became available in the 286.

Note that 386 technology has been realized in several processors including the 386SX, 386SL and 386DX. The 386SX processor uses the 386 32-bit architecture internally, yet has a 16-bit external data path. The 386SL chip is a low power version of the 386SX with built-in power management features and is primarily designed for battery-powered computers. The 386DX processor (basically a renamed version of the original 386) uses an internal 32-bit architecture and a 32-bit external data path.

All 386 processors are functionally equivalent and are referred by the 386 moniker for the rest of this document.

2.14.4 The 486

The latest member of the 80x86 family to be introduced was the 486 processor. Basically this is similar to a 386 processor with an internal memory cache and is faster due to improved instruction execution. The 486 appears in several variants including a basic 486SX, a low power 486SL and a 486DX version that sports an internal math coprocessor (an optional external component with the 486SX,SL and all the other previous processors). Another variant is the 486DX2 processor which appears to a computer system much like a regular 486DX chip, but executes instructions internally at twice the speed of a 486DX.

All 486 processors are functionally equivalent (save for math functions) and are referred by the 486 moniker for the rest of this document.

2.15 DOS Extenders

Since DOS cannot run in protected mode, a way was devised for protected mode applications to run under DOS and use other real mode services. Protected mode applications are desirable since they have access to up to 16MB of memory on a 286 and 4 Gigabytes on a 386/486.

A **DOS Extender** is a special utility that is linked in to a protected mode application. Whenever the application makes a DOS call or any other request that requires real mode, the DOS Extender copies down any necessary data into the 1MB conventional memory area and switches into real mode. It then calls the requested function and on return switches back into protected mode, returning any results to the protected mode application.

There are usually two types of DOS Extenders - 286 DOS Extenders and 386 DOS Extenders.

- | | |
|--------------------------|--|
| 286 DOS Extenders | These run 16-bit protected mode applications on a machine with a minimum of a 286 processor. They have access to a 16MB address space. |
| 386 DOS Extenders | These run 32-bit protected mode applications on a machine with a minimum of a 386 processor. They have access to a 4GB address space. |

Note that some DOS Extenders combine the capabilities of the two different types and can handle both 16-bit (286) protected mode applications as well as 32-bit (386) protected mode applications.

Most DOS Extenders also have a **virtual memory** option. That is, a DOS Extended application may run in less memory than normally is required by using virtual memory techniques.

In essence, the DOS Extender becomes the system's **control program**. This normally would have posed a problem to DESQview as protected mode allows only one control program in a system. Since DESQview multitasks applications, multiple DOS Extended applications would conflict with each other as each expects to be the control program. This is compounded with the fact that DESQview 386 (DESQview plus QEMM-386) is also a control program.

To obviate this problem, Quarterdeck and Phar Lap (one of the companies that produce a DOS Extender) developed the VCPI (Virtual Control Program Interface) specification which has been adopted by all major 386 DOS Extender manufacturers - see the "VCPI Specification" section for details.

It should be noted that VCPI is a specification for 386 and 486 processors, yet 16-bit protected mode applications may be run on 286 machines. In order for DESQview to multitask multiple 16-bit protected mode programs on a 286 so that they do not assume control of the same blocks of extended memory, their individual 286 DOS Extenders must use the **XMS** (Extended Memory Specification) interface specification. A utility program called QEXT.SYS supplies the necessary XMS

services for 286 DOS Extenders running under DESQview on a 286 machine whereas QEMM-386 supplies the services for DESQview 386.

Note that a DOS Extended application consists of two parts. A real mode portion of the DOS Extender resides in conventional memory and interfaces with the protected mode portion that resides with the protected mode application in extended memory. When DESQview performs a task switch to a DOS Extended application, it ensures that the real mode portion of the application is mapped into the conventional memory Application Area and that the protected mode portion is "visible" in extended memory. Since the majority of the application resides in extended memory and only a small portion (the real mode part) need occupy the Application Area, DOS Extended applications tend not to be constrained by the size of the Application Area as regular real mode applications are.

Note: DESQview/X includes a built-in DOS Extender supporting 16- and 32-bit virtual memory and dynamic link libraries.

2.16 VCPI Specification

The VCPI specification was developed so that multiple protected mode control programs can coexist and interact within a single 386 (or 486) system. The specification consists of two parts - a VCPI server and several VCPI clients. The VCPI clients request memory and mode switching services from the VCPI server.

In a DESQview 386 system, the VCPI server is implemented within QEMM-386 and the DOS Extended applications become VCPI clients. Whenever a DOS Extended application requires memory services it calls upon the VCPI server to perform them. When QEMM-386 is not present, the DOS Extender performs all services for itself. The end result is that DESQview is able to run a mix of real mode and DOS Extended (protected mode) applications concurrently on a 386/486.

As mentioned earlier, 286 machines may run multiple 286 DOS Extended applications only if the DOS Extenders utilize XMS services.

2.17 DESQview Capabilities

DESQview's ability to window an application and run it in the background is a function of the machine's processor and the type of application. Here is a table that summarizes the possible combinations:

DESQview Capabilities		8088 8086	286	386 486
Well-behaved Text Application or Ill-behave Text Application with Loader	Real Mode	W	W	W
	16-bit Protected	-	W	W
	32-bit Protected	-	-	W
Ill-behaved Text Application	Real Mode	D	D	W
	16-bit Protected	-	D	WD
	32-bit Protected	-	-	WD
Graphics Application	Real Mode	D	D	W
	16-bit Protected	-	D	D
	32-bit Protected	-	-	D
Microsoft Windows 3.0, 3.1 and Windows Application	Real Mode*	D	D	W
	Standard Mode	-	D	D
W Application can run in a window and in background. D Application can only run direct (full screen) and not in background. WD Dependent on individual application - most run as W, some may run as D. - Processor cannot support this type of application. * Available only with Microsoft Windows version 3.0. Note: The above table presents the capabilities of the DESQview multitasker. For information on DESQview/X capabilities please see page QD-26.				

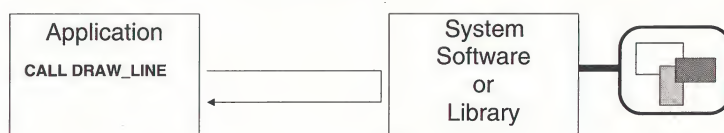
3 An Introduction to X

The basic concepts of the X Window System are described in this section. Readers familiar with X may elect to skip this section.

The X Window System is a powerful concept that utilizes machine and device independence as well as providing a graphical interface to users with both keyboard and mouse support.

3.1 Traditional Graphics Output

In traditional systems, if an application wishes to produce graphical output on a computer's display device, it will typically call a library or system software graphic subroutine. This subroutine performs the task requested (in the example shown, draw a line) and once the task has completed, control returns to the application.



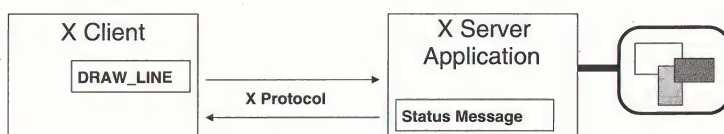
Traditional Graphics Output

3.2 X Servers, Clients and Protocol

In an X Window System, the system software is replaced by an application called the **X Server** - it is this application that has complete control of the display screen. An application that wishes to produce graphical output instructs the X Server to perform a specific task by sending it an information "message" that describes the task required. Sending a message to an X Server returns control immediately to the application and may or may not provoke a response from the Server.

The different types of messages are collectively called the **X Protocol**. One message draws a line, another a circle and yet another may print some text.

Any application that displays graphical output by sending X Protocol messages is labelled an **X Client** in contrast to an application that uses some other means.



X Window Graphics Output

In return the X Server may send back to an X Client special messages, such as event messages or error messages. These special messages are also part of the X Protocol.

X Clients typically create windows for their output. It is quite feasible (and generally the case) that a single X Client will create and utilize several windows on the X Server's screen simultaneously.

Note that an X Server may handle the graphics output for multiple X Clients concurrently and only understands X Protocol requests as a means to produce graphical output - it usually does not produce graphics output any other way.

3.3 An Event-Driven System

X is an **event-driven** system. That is, X Clients are typically suspended until an action occurs on the X Server for which they have a vested interest. X Clients are restarted by the X Server sending them special X Protocol messages. These event messages include ones that instruct an X Client to redraw its window (for example, if a part of its window becomes uncovered by the movement of another window), that a window's size has changed or that a key has been pressed. An X Client processes these messages, producing whatever output may be necessary and then returns to a suspended state until another message is received.

This is in direct contrast to the way traditional applications have been written. Those applications are **procedure-oriented** and are written to assume an active role in the interrelationship between the user and the program. Typically, the program will steer the user through the execution of the task at hand, forcing the user down a narrow set of predefined procedures. The program only accepts input (be it keystrokes or mouse clicks) from the user at predictable times. An order entry application is a good example of a procedure-oriented program.

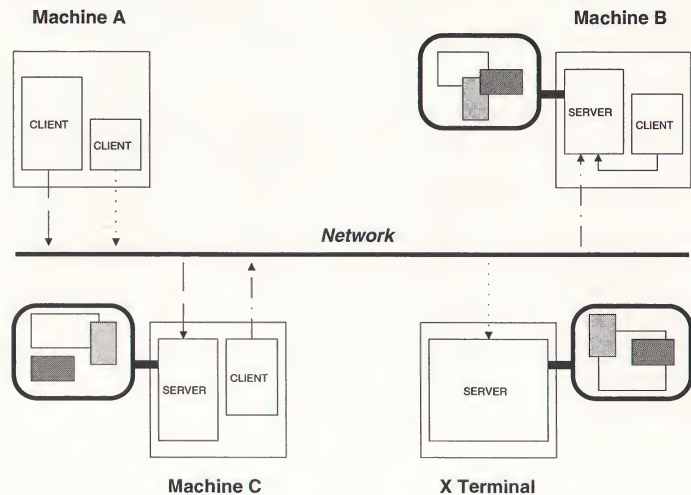
Event-driven applications take a more passive role in that they respond to input from the user or the system at unpredictable times. This type of application can provide a more flexible framework within which a user may operate. Typically there are no predefined procedures and many ways to complete a task - a user is free to use whatever tools the application provides and in any manner desired to achieve the final result. A drawing/designing type of program is a good example of an event-driven application.

3.4 A Distributed System

Since the X Client communicates with the X Server through information messages, it is possible for the X Protocol requests to be sent over a network to an X Server running on a different machine.

In fact the X Window System was designed around a system of messages specifically to be a networked graphical system.

In the diagram, an X Client executing on machine A is displayed on machine C's screen (using the X Server on C) and an X Client executing on machine C is being displayed on machine B's screen (using machine B's X Server).



3.5 Operating System and Architecture Independence

None of the machines need be from the same vendor or running the same operating system, since all communication between X Clients and Servers is performed over a network using a well-defined message protocol (the X Protocol). Naturally, a program cannot be copied to a different type of machine on the network and subsequently run - it would have to be recompiled for a different machine's architecture/operating system.

3.6 X Terminals

In the previous diagram, one of the clients running on machine A is being displayed by a special machine that only has an X Server running on it - in effect acting as a remote graphics terminal to machine A. This type of machine is called an **X Terminal** and its sole purpose is to display graphics from X Clients running on remote machines.

Typically, the majority of PC implementations of the X Window System have been as X Terminals. PCs are notorious for memory limitations and hence an X Server application would normally occupy all of the PC's memory. With the advent of DESQview/X, however, PCs can run X Servers, DOS applications, Microsoft Windows and X Clients simultaneously.

3.7 A Stand-Alone System

In the previous diagram, machine B's X Server was displaying output from an X Client running on machine C, but is also displaying graphics from an X Client running on itself. In this case, the X Protocol messages are not sent out over the network to another X Server, but are routed within the machine to the local X Server.

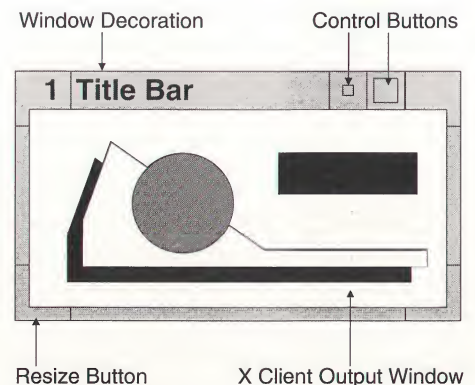
This concept can be extended to include a scenario whereby the machine is not connected to a network - all X Clients run locally and are displayed by the local X Server. Naturally, this requires a multitasking operating system - such as DOS with DESQview.

3.8 The Window Manager

The X Server only produces graphical output according to X Protocol requests and does not provide functions for the user to control the size, position and stacking order of the displayed windows.

These functions could have been implemented within each X Client, but would have lead to much redundant programming. They could have been implemented within the X Server itself, but the designers of the X Window System took a more flexible approach.

A special X Client is run (either locally or remotely) for each X Server, called the **window manager**. This program is given special privileges and is allowed to "supervise" all of the windows being displayed by the X Server. The window manager will typically place some form of window decoration around the outside of each X Client window that includes resize and move buttons as well as a title bar. It then becomes a function of the window manager to resize, move, rearrange a window according to the wishes of the user by mouse clicks on a window's decoration or selections from a window manager menu.



At present, there are several managers for the X Window System, the most prominent of which are the OSF/Motif, OPEN LOOK and the Tab (previously known as Tom's) Window Managers. DESQview/X also supplies its own window manager, DESQview Window Manager (DWM).

Due to the design of the X Window System, a window manager may be closed down and another may be subsequently started—without affecting any of the X Clients being displayed on the screen! The old window decorations disappear from the screen and are replaced by new decorations created by the incoming window manager.

Note that the window manager only creates the “look and feel” of an X Client with regards to its window decoration. Whatever an X Client chooses to display in its output window is independent of the window manager. Program libraries are available to X Client developers that allow them to create an application with a specific look - either an OPEN LOOK or OSF/Motif look, for example. These program libraries are called toolkits and are explored in the next section.

3.9 X Development Layers

In order to create an X Client, a developer will call upon a variety of program libraries for assistance. For DESQview/X, these libraries can be linked into each X Client, or may be a shared resource among all X Clients on a system through the use of Dynamic Link Libraries (DLLs).

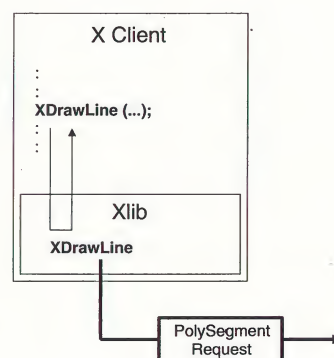
3.9.1 Xlib

For an X Client to be able to communicate with an X Server, it needs to generate X Protocol requests for transmission to the Server. Building these requests can be cumbersome and hence a library was created called **Xlib**. Xlib is (generally) the lowest level interface that an X Client uses to communicate with the X Server. It is a set of C subroutines that, for the most part, are a one-to-one mapping from C to X Protocol requests, though some Xlib functions can generate multiple X Protocol requests.

For example, if an X Client uses the function `XDrawLine` it calls the appropriate code inside Xlib which builds a PolySegment request and transmits it to the X Server.

Note that the Xlib library imparts no specific “look and feel” to an X Client - it merely consists of requests to create a window, draw a line, print some text, etc. The appearance of an application is generally determined by another program library - a toolkit.

X Clients may be written so that they use only Xlib and no other program libraries (toolkits).



3.9.2 Toolkits

Since Xlib is rudimentary in the scope of its capabilities, another program layer may exist on top of Xlib - the **toolkit**. Toolkits generally have routines for building menus, push buttons, slider controls and the like. Since the toolkit generates these basic window components for the X Client, it is the toolkit which creates the actual “look” of an application.

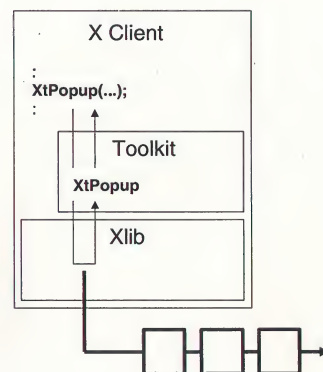
An individual toolkit function may call several Xlib functions, which in turn can create multiple X Protocol requests.

For example, if the X Client wishes to make a popup window appear, it could call (using one specific toolkit) `XtPopup` to perform the function. `XtPopup` in turn makes several Xlib calls which may generate multiple X Protocol requests.

An X Client may still (and often does) call Xlib functions even if it uses a toolkit.

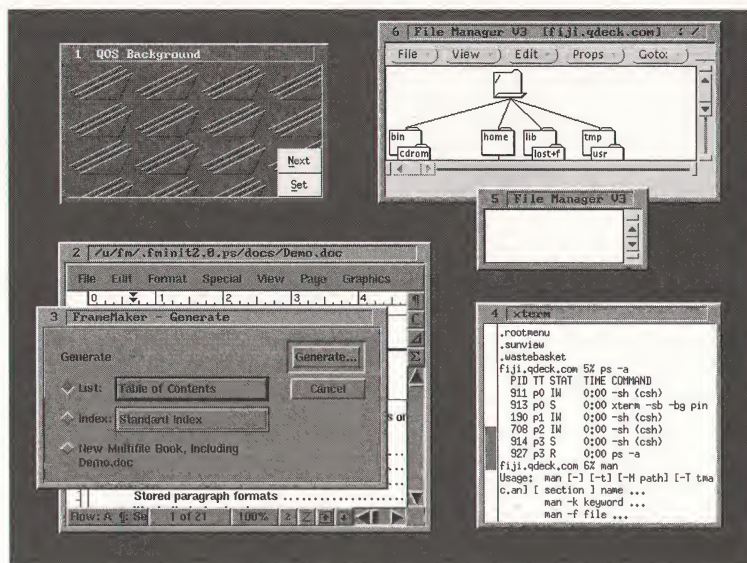
Some of the more prominent toolkits that are generally available are as follows.

Athena Toolkit	A fairly rudimentary toolkit supplied by MIT (Massachusetts Institute of Technology).
OSF/Motif Toolkit	This toolkit is supplied by the Open Software Foundation and provides a sculptured 3D look. This toolkit (and its complimentary window manager) is promoted by a consortium of companies (OSF) that include DEC, Hewlett-Packard and IBM.
Olit Toolkit	A toolkit conforming to the OPEN LOOK* graphical user interface standard that is 3D in appearance. This toolkit and its OPEN LOOK window manager is promoted by Unix System Laboratories.
XView Toolkit	A toolkit conforming to the OPEN LOOK* graphical user interface standard, but with a different programming interface (SunView) than Olit. It is promoted by Sun Microsystems.



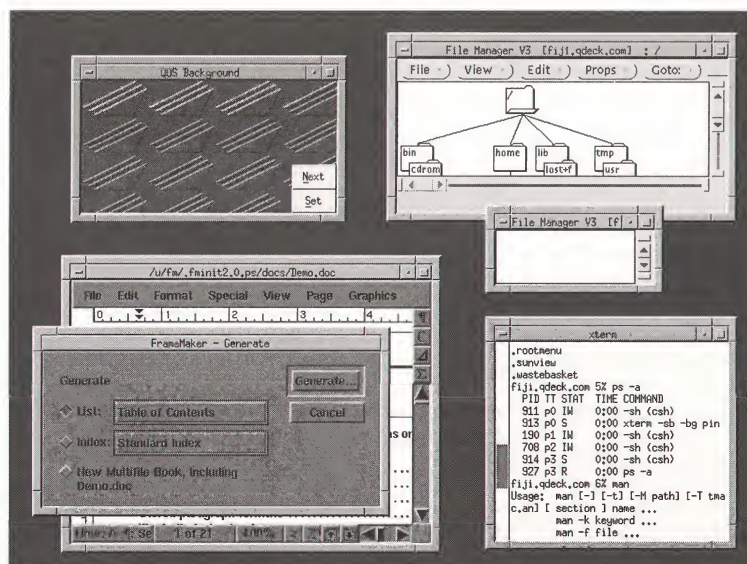
*Note that OPEN LOOK is not a toolkit or window manager in itself - it is merely a design specification for the appearance of a user interface. Olit and XView are toolkits that adhere to this specification and hence create the same look and feel.

The following screen shots should help to illustrate the concepts of a Window Manager, Toolkits and the like.



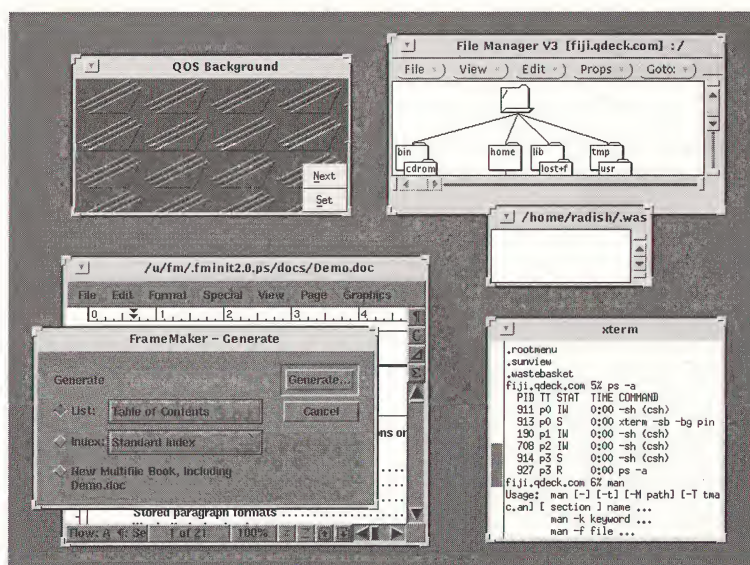
The X Clients in the previous picture are:

- QOS Background** An X Client written using only Xlib. A Toolkit is not necessary since it only creates a simple output window.
- FrameMaker** This electronic publishing package was written using the OSF/Motif Toolkit. The X Client is currently displaying two windows - an edit window and a "Generate" window.
- Sun File Manager** OPEN LOOK has characteristic buttons with rounded ends. This file manager, which uses an OPEN LOOK toolkit, has these rounded buttons. This X Client is currently displaying two windows - a directory tree and a wastebasket box.
- Xterm** This X client uses the Athena Toolkit to display a terminal session with a scrollbar on the left.
- All of these X Clients are running under the control of the DESQview/X Window Manager. The window manager has placed a frame around many of the windows on the screen, along with decorations such as title bar and window number.
- If the DESQview/X Window Manager is closed down and the OSF/Motif window manager is started, the following display appears:



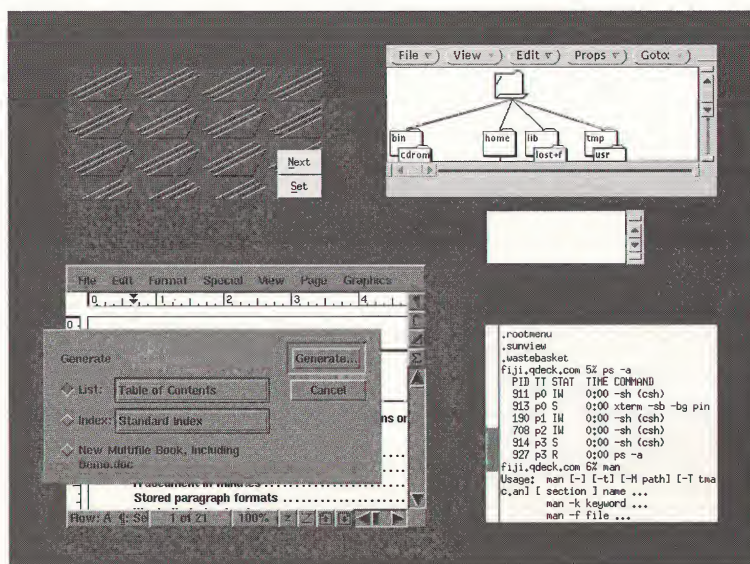
Despite a change in window managers, the X Clients' window contents remain the same. Only the window decoration has changed - in this case to an OSF/Motif 3D effect. Note that with the OSF/Motif window manager active, the X Client built using the OSF/Motif toolkit (FrameMaker) blends well into the environment, since it has the same appearance style as the window manager.

If the OSF/Motif window manager is now replaced by an OPEN LOOK window manager, the following display appears:



Once again a change in window managers does not change the contents of the X Clients' windows - only the window decoration has altered. In a similar fashion to FrameMaker and the OSF/Motif window manager, it can be seen that the Sun File Manager windows complement the OPEN LOOK window manager's window decoration. This is because both of these products were built using an OPEN LOOK toolkit and hence have an OPEN LOOK appearance.

Although it is unlikely that a user would want to run X Clients without a window manager, the following picture shows how this would appear:



As can be seen in the previous picture, the usefulness of having no window manager is debatable, but not impossible. Having no window manager active would most probably occur when only one X Client is being run on an X Server.

These pictures highlight the concept of a window manager as being a special X Client that decorates the outside of all other X Clients' windows and allows a user to control their size, position and ordering on the screen. The pictures also show how a toolkit influences the look and feel of an X Client and how its appearance is independent of the active window manager.

3.9.3 Intrinsics and Widgets

Some toolkits may only be regarded as a single entity, but others are conceptually split into two parts. One of these parts is termed the Intrinsics and the other part, a Widget Set.

The Widget Set

Widgets are abstract data objects such as buttons, scrollbars and other such objects. An X Client can be easily constructed from a number of widgets. The X Client does not have direct control of the actual appearance of a widget - only its general form, size or contents. The appearance is determined by the toolkit.

A **Widget Set** uses both function calls in the Intrinsics as well as Xlib.

The Intrinsics

The **Intrinsics** provide an object-oriented framework on which a Widget Set depends. It handles the creation, deletion and management of widgets as well as their event message handling. It is possible for an X Client to call the Intrinsics directly as well as the Widget Set (and of course, Xlib).

The Athena, OSF/Motif and Olit Toolkits consist of a Widget Set and the first Intrinsics to be developed for X - Xt.

3.9.4 Xt Intrinsics

In some cases, an X Client may only call the Xt Intrinsics and Xlib library. This type of application provides its own widget set, hence supporting its own unique set of abstract data objects (widgets) that are manipulated and managed by Xt.

An application that does this is able to provide its own look and feel, all the while saving its developer time and effort by using the object-oriented functions of Xt.

3.10 X11

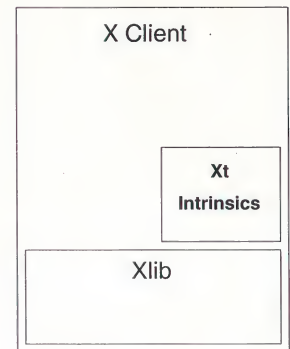
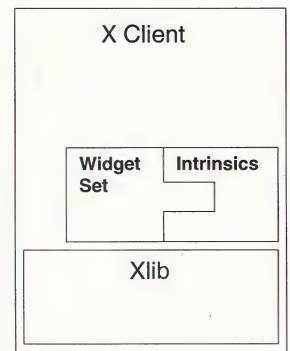
MIT in association with a consortium of companies who have a vested interest in the X Window System (The X Consortium) releases MIT X distribution tapes containing the Xlib and Xt libraries as well as sample X Clients and an X Server. It is these tapes on which all other toolkits and X products are based.

The current revision of these distribution tapes is the X version 11 release 5 of the X Window System, otherwise known as X11 R5.

3.11 Toolkit Summary

Here follows a table of the Toolkits discussed in this document in summary form for quick reference:

Toolkit	Supplier or Promoter	API	Interface
Athena	MIT	Xt	(rudimentary)
OSF/Motif	OSF	Modified Xt	OSF/Motif
Xview	Sun Microsystems	SunView	OPEN LOOK
Olit	USL	Modified Xt	OPEN LOOK



4 DESQview/X

This section describes how the X Window System is integrated into the DESQview environment resulting in DESQview/X and highlights the capabilities of the combined system.

4.1 Minimum Requirements

DESQview /X currently requires a minimum of a 386SX processor, an EGA display, 4MB of RAM and 10MB of free hard disk space. In addition, a mouse is highly recommended.

4.2 General Structure

The general structure of a stand-alone DESQview /X system is shown to the right.

DESQview is loaded on top of DOS, the first program booted into the computer. Multitasking within DESQview can be several program partitions - one containing an X Server in the case of DESQview /X.

4.2.1 The X Server

Display output for the system is provided by the X Server program. The X Server is run within a DESQview partition and is multitasked along with all of the other programs in the system. The X Server in DESQview /X v1.0 is based on Release 4.0 of the X Window System.

The X Server controls the display screen (for the most part) and hence the display resolution of the system and compatible display types are determined by the X Server and not by DESQview. Currently EGA, VGA, Super VGA, 8514/A and DGIS displays are supported. XGA, TIGA and S3 displays are expected for the future - check with Quarterdeck Office Systems for an up-to-date list of displays supported.

The X Server is run as a DOS Extended application (up to 16MB) - this gives the X Server more workspace to perform its display functions and enables it to handle more windows concurrently. It is also available in virtual memory form so that it may use less memory than is normally required.

4.2.2 Socket Driver

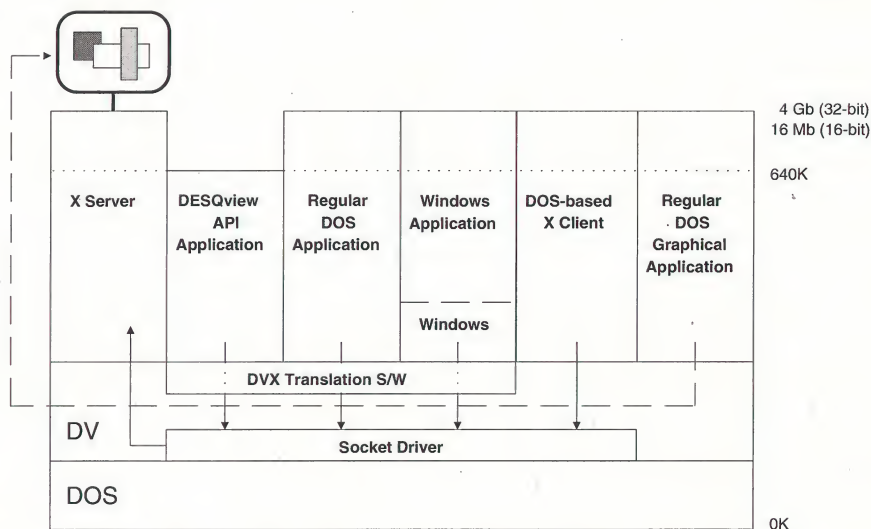
Communication in most X Window Systems is accomplished using the Berkeley Socket interface. Consequently, DESQview /X includes the DESQview /X Socket Driver, which accepts these communication requests and intelligently routes the message to the appropriate destination. In the case of a standalone DESQview /X system, the messages are always routed between the X Server and the applications using the X Server for output. Note that the DESQview /X Socket Driver is loaded as part of the DESQview multitasking kernel.

4.2.3 Regular DOS Applications

If a regular real mode DOS application (for example WordPerfect or Lotus 123 release 2) is running within the system, its display output is translated dynamically (that is on-the-fly) by special DESQview /X Translation Software into X Protocol requests. These X Protocol requests are sent using the Berkeley Socket interface to the Socket Driver which routes them to the X Server for output. In effect, a DOS application is made to appear like a regular X Client.

DESQview /X does this for well-behaved applications by trapping their BIOS and DOS calls and converting them into X Protocol requests.

In the case of ill-behaved real mode applications DESQview /X **virtualizes** the application. DESQview /X remaps the application's video RAM to a different portion of memory and scans this **logical window buffer** for any changes, producing X Protocol requests from the scanning process. Note that this process requires a minimum of a 386 processor - the 286 processor lacks the necessary hardware to perform the remapping operation.



If a regular DOS application is DOS Extended (for example Lotus 123 release 3 or Paradox) and is running within the system, it is treated much the same as a regular real mode DOS application. The major difference being that DOS Extended applications have a far greater workspace available to them than do regular DOS applications (up to 16MB for a 16-bit protected mode application, 4GB for a 32-bit protected mode application).

4.2.4 DESQview API Applications

DESQview API Applications are, by their very nature, well-behaved DOS applications as they use the DESQview API to perform display output. However, the DESQview API allows these applications to create multiple windows as well perform display output to these windows.

This is handled in DESQview/X by intercepting all of the DESQview API calls and generating equivalent X Protocol requests, turning a DESQview API application into what would appear to be an X Client, just as with a regular well-behaved DOS application.

4.2.5 Microsoft Windows and Windows Applications

If Microsoft Windows 3.0 or 3.1 is running in a DESQview/X system along with one or more Windows applications, DESQview/X dynamically translates all Windows display output into X Protocol requests, much the same as it does with regular DOS applications. In effect, Microsoft Windows and Windows applications are made to appear like a regular X Client.

Because of this, a Microsoft Windows session can appear within a resizeable DESQview/X window alongside other X Client windows.

4.2.6 Regular DOS Graphical Applications

Translating a DOS application's graphics screen into X Protocol requests is possible, but is not implemented in DESQview/X Version 1.0. Currently, DESQview/X runs all regular DOS graphical applications as full screen applications only.

4.2.7 X Clients

X Clients may be running on a DESQview/X machine in one of three forms. If small enough to fit within the conventional memory Application Area, they may run in real mode. If larger, they require a DOS Extender to reside in the system. If the X Client is a 16-bit protected mode application, it may be as large as 16MB. If it is a 32-bit protected mode application, the X Client may (theoretically) be as large as 4GB.

Since X Clients already produce X Protocol requests (unlike DOS or Microsoft Windows applications), they need no translation software. Instead, their X Protocol requests are sent to the Socket Driver from the applicable Xlib routines using the Berkeley Socket interface (the standard method of communication in an X Window System). The Socket Driver then routes them directly to the X Server for display output.

Note that these X Clients may be ported from other X platforms (such as many Unix machines) or else may be developed directly under DESQview/X - see the "Development Issues" section for details.

It should be remembered that an X Client is similar to a DOS graphical application in that it produces graphical output, but is very different in the way it achieves this. DOS graphical applications usually write directly to video RAM; an X Client uses X Protocol requests to an X Server to produce the same effect. Thus an X Client can always be windowed.

4.3 Direct Windows

Note that regular DOS and Microsoft Windows applications can be configured to bypass the DESQview/X translation software and run as full screen direct windows (like regular DOS Graphical applications). Doing this eliminates the overhead of translating an application into X protocol requests, resulting in an increase of display speed, but at the expense of the application not being able to display on a remote machine.

4.4 Available Memory

In a typical DESQview/X system, real mode applications usually have at least 500K available to them regardless of their type - DESQview API, regular DOS or otherwise.

DOS Extended applications (which includes Microsoft Windows in standard mode), on the other hand, are usually constrained only by the total amount of memory in the system.

4.5 The Window Manager

Since a user will want to control the windows displayed on the screen by the X Server, a minimum of one X Client will normally be run in a DESQview/X system - the window manager. The window managers that are currently available include:

DWM	The DESQview/X Window Manager provides a 3D sculpted look and has a menu system similar to DESQview. In addition, it boasts popular DESQview features such as Mark & Transfer and scripts. Best of all, DWM is under 100K in size!
OSF/Motif	Using the OSF/Motif 3D sculpted look, this window manager is a DOS Extended X Client.
OPEN LOOK	This window manager implements the OPEN LOOK graphical user interface and is a DOS extender X Client.

4.6 Fonts

The X Window System (through Release 4.0) has typically relied on bitmapped fonts to produce text output on an X Server. That is, a bitmap exists for a specific typeface (for example, Helvetica or Times Roman) realized at a specific point size. If an X Client requests a particular size of typeface and that size is not available (even though other point sizes in that typeface are available), the X Server would normally tell the X Client that the font does not exist and the X Client either terminates or uses a different font.

Drawbacks to this technique include the limited availability of a typeface to a few point sizes (typically 8 to 24) as well as excess use of hard disk space to store the different sizes that are supported.

4.6.1 Scalable Fonts

With the advent of laser printers, Adobe Systems, Inc introduced the PostScript printing language that took a different approach. Each typeface file was coded in such a way that the printer could scale an individual typeface to any size required. This new file format and the typefaces that were encoded in it are termed "Adobe Type 1 fonts".

The "intelligence" inside of the laser printers that produces the scaling function is actually a sophisticated computer program developed by Adobe Systems, Inc. This technology has been licensed by Quarterdeck Office Systems, Inc and has been incorporated transparently into the DESQview/X system. These font extensions, in no way prohibit continued support of Quarterdeck's scalable fonts when DESQview/X supports the X Window System Release 5.0 (which does define the use of scalable fonts).

When an X Client requests a typeface at a particular size, the DESQview/X X Server first checks its list of available fonts - this font list contains both bitmap and Adobe Type 1 fonts. If it cannot find either a bitmap font of the correct size or a scalable font that can be scaled appropriately, the X Server will return an error. If, however, a font was found, the X Server checks to see if it is presently loaded into memory (for another X Client). If necessary, the X Server will load the font and (in the case of Adobe Type 1 fonts) scale it to the requested size.

4.6.2 Using Scalable Fonts

Advantages of the scalable font technology include an almost endless choice of point sizes for a particular typeface as well as the subsequent economies of hard disk space. In addition, the Adobe Type 1 font format has proved to be the most popular and prolific file type resulting in a vast choice of Type 1 typefaces currently available.

Since the interface for using a scalable font is identical to that for requesting a bitmapped font, an X Client which has no knowledge of scalable fonts may, in fact, be given a scalable font realized at a particular point size if the requested bitmapped one is not present!

On the other hand, an X Client that has been written to recognize scalable fonts can use them to its advantage by creating fully scalable windows, wherein if a user resizes a window, the contents of the window (including the text) scales accordingly. In addition, this kind of X Client can also make use of the fractional spacing and kerning information that is stored in the scalable font file. One example of an X Client that uses scalable windows is the Adobe Type Manager that is supplied with DESQview/X which allows a user to install or delete Adobe Type 1 fonts from a DESQview/X system.

4.6.3 Scalable DOS Windows

Scalable fonts have also been used to great advantage in DESQview/X when displaying DOS text windows (regular DOS applications). When instructed to do so, DESQview/X will scale a DOS window to whatever size the user resizes the window - from a window that occupies the full screen all the way down to a size where each character in the window is represented by only a single pixel!

The benefits of this technology become clear within minutes of using it - a user can view many more DOS windows simultaneously than was previously possible and can shrink a window down to its minimum size in order to keep an eye on the DOS application's progress in background (for example, when performing a long file transfer with a communications program).

4.7 Advanced Memory Management

Incorporated into DESQview/X is the DOS/4GX Extender technology from Rational Systems, Inc that provides many useful benefits in the area of memory management.

With this technology, it is possible for DESQview/X to run all three types of application for the PC (real mode, 16-bit protected and 32-bit protected) directly. This produces a substantial saving in memory overhead for protected mode applications.

In addition, the DOS/4GX technology also provides both virtual memory and dynamic link library (DLL) capabilities to protected mode applications.

Note, however, that only applications generated specifically for the DOS/4GX Extender can call upon the DOS/4GX technology in DESQview/X. This does not, however, preclude applications developed using other DOS Extenders from running in a DESQview/X system - they will simply not be as memory conscious as a DOS/4GX application since a separate copy of the DOS Extender will be loaded for each instance of the program. In addition, they will not be able to take advantage of virtual memory or dynamic link libraries unless their individual DOS Extender supports these features.

4.7.1 Virtual Memory

Virtual Memory is a technique used in advanced computer systems, wherein an application is divided up into discrete chunks - usually these chunks are regular in size and are called "pages" (otherwise if the chunks are irregular in size, they are called "segments", though for the rest of this section the former term will be used).

When an application is actively running, it typically only uses a few pages of the program in a given time frame - these active chunks are referred to by computer scientists as the "working set" of pages. Since only a few pages are being used at any one time, a large program can waste a lot of memory in a system with inactive pages that may never even be used.

To maximize the use of memory, a computer can load only the working set of pages into memory and run the application as normal. If the application requires a page that is not currently in memory (for example, when "jumping" to a different part of the program, crossing over from one page to the next or accessing a piece of data), a "page fault" is generated by the computer hardware. At this point, the computer chooses a page not being used, swaps it out to hard disk, reads in the required page and then continues executing the application. This process is totally invisible to the application and requires no special programming by the application's developer, hence the term "virtual memory" since the memory always appears to be present to the developer, though physically it may not be all the time.

It is important, however, that sufficient memory is available to hold an application's working set - too little memory will cause page faults to happen with greater frequency so that the computer will spend most of its time accessing the hard disk.

With its DOS/4GX technology, DESQview/X provides this virtual memory option so that more applications can be run concurrently than the amount of memory would normally dictate.

4.7.2 Dynamic Link Libraries

Most applications call on a standard set of routines which need to be duplicated in every application that uses them. Typically these routines are stored in a library of routines and are "linked" in when an application is being generated (at compile time). A good example of this would be the Xlib programming library that is required by X Clients.

Naturally, this leads to a waste of both computer memory and hard disk space as the same information appears in separate applications.

Dynamic Link Libraries (or DLLs) are a way of sharing these routines among several applications. The routines are stored on disk in only one place - the dynamic link library - saving space on a computer's hard disk. Whenever an application is loaded that requires a specific DLL, the computer first checks to see if that DLL has already been loaded for another application. If it has been loaded, the computer points the application to the DLL already in memory. If it is not loaded, the computer will load the DLL first before it can be used by the application. Since multiple applications use the same copy of the DLL while running, memory space is conserved. Note that when all applications using a DLL terminate, the DLL is discarded from memory as it is no longer needed.

Along with the advantages of saving disk and memory space, DLLs also provide another benefit known as "late-binding". Early-binding occurs when routines are linked into an application at compile/link time on the application developer's machine - the application becomes a single entity that cannot be changed unless the developer issues an update. DLLs, by their very nature, exhibit late-binding - the linking process occurs at run time, on the user's machine, after the application was compiled.

This difference seems trivial until a scenario is considered whereby several different applications from different manufacturers (or even the same manufacturer) use the same DLL. Assume the DLL provides access to a particular type of device, a tape drive for example, and that the drive manufacturer releases a new drive with a slightly different hardware

interface. Without DLLs, all applications that used the previous tape drive would have to be recompiled by their respective companies and updates sent to existing customers that purchase the new drive. With DLLs, only a new DLL need be produced and distributed to customers along with the new drive. The more applications that use a particular DLL, the bigger the advantage of late-binding. Note that DLLs are not updated solely because of new features, but can also be updated because of enhancements to a DLL's routines.

With its DOS/4GX technology, DESQview/X can conserve both disk and memory space as well as delivering the advantages of late-binding through the availability of a dynamic link library option.

4.8 Print Server

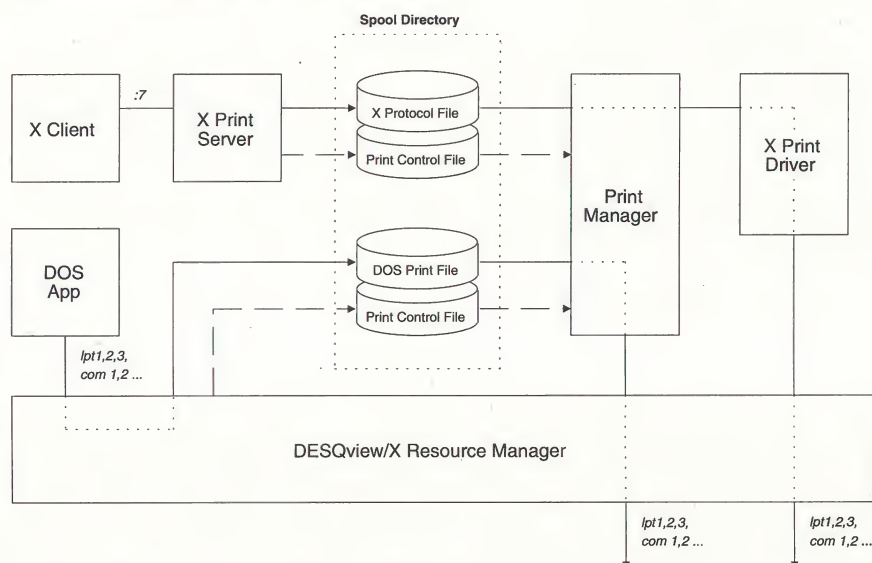
The DESQview/X Print Server consists of several components - a Print Manager, an X Print Server and an X Print Driver. In addition, the Print Server calls upon the services of the DESQview/X Resource Manager when printing from DOS applications.

For DOS applications, DESQview/X may be configured such that it will manage contention for the same printer and can spool the print information to disk until a printer is ready to receive it. (Note that DESQview/X can also be configured such that no spooling or contention management is performed and printer output is routed directly to a printer.)

For X Clients, DESQview/X always spools X Protocol requests to disk and translates these requests into the appropriate printer commands thus providing a single output imaging model.

The components of the DESQview/X Print Server and the interrelationships between those components are shown to the right.

Despite there being the interaction of several components in order to print a file under DESQview/X, the user normally only sees and interacts with the Print Manager (which provides choices such as holding, resuming and killing print jobs). The X Print Driver is a "daemon" (unseen) process that is both created and killed by the Print Manager, the X Print Server is implemented inside of the X Server process and the DESQview/X Resource Manager is a special driver loaded by the DESQview multitasker.



4.8.1 DOS Application Printing

When a DOS application prints to a printer, it does so through either the printer ports LPT1, LPT2, LPT3, the communication ports COM1, COM2, or the DOS file handle 4. When running in DESQview/X, the DESQview/X Resource Manager traps these requests and spools the print information into a DOS print file as well as creating a print control file that specifies additional information (such as which printer to print the file on and the number of copies). These two files are created in the DESQview/X spool directory. The Resource Manager then informs the Print Manager of the file that needs printing, whereupon the Print Manager adds the request to the end of its print list.

When the Print Manager is ready to print a particular file, it reads the information from the relevant printer control file and routes the DOS print information from the file to the correct printer. The Resource Manager recognizes that it is the Print Manager trying to print and allows the printer information to pass through (via the printer ports LPTx, communication ports COMx or DOS file handle 4) instead of trapping the print operation.

Note that DESQview/X does not alter the DOS print information in any way. Therefore, all DOS applications must be configured correctly for the printer type attached to a DESQview/X system (PostScript, IBM Proprinter or otherwise).

4.8.2 X Client Printing

Unfortunately, the X Window System does not define a standard for X Clients to produce printer output, with each system manufacturer taking their own approach. It was decided for DESQview/X that printing from an X Client should be performed using exactly the same method as for displaying output on the screen, that is, by using the X Protocol.

This single imaging model has the distinct advantage of simplifying the coding of X Clients as they need only support one type of output device - regardless of whether the output is destined for the screen or printer. In addition, this also makes existing X Clients easier to update to include printing capabilities.

Under the X Window System, an X Client specifies on which X Server it wishes to display output by means of an address that takes the form machine_name:display_number.screen_number (note that in X, the term "display" refers to a workstation that consists of a keyboard, a pointing device and one or more screens). Hence the address radish:2.1 refers to the second screen (0 is the first and 1 is the second) on the third workstation (0,1 then 2) on the machine called "radish" on the network.

If an X Client connects to a DESQview/X workstation using the display number 7, for example radish:7, (note that if a screen number is not specified it is presumed to be 0), the X Print Server in the DESQview/X X Server recognizes this and spools the X Client's X Protocol requests into a file in the DESQview/X spool directory. In addition it also creates a print control file that specifies additional information for the Print Manager.

When the X Client disconnects from display number 7, the X Print Server informs the Print Manager of the file that needs printing, whereupon the Print Manager adds the request to the end of its print list.

When the Print Manager is ready to print a particular file, it reads the information from the relevant printer control file and, recognizing that the file is an X Protocol file, passes the file over to the X Print Driver for processing. Note that the X Print Driver is under the control of the Print Manager which both starts and removes the X Print Driver from the system as necessary. When the X Print Driver is handed an X Protocol File, it translates the X Protocol requests into the necessary printer codes and outputs them to the X Printer connected to the DESQview/X system.

The Resource Manager recognizes that it is the X Print Driver trying to print and allows the printer information to pass through (via the printer ports LPTx, communication ports COMx or DOS file handle 4) instead of trapping the print operation.

Note that only one printer may be designated as the X Printer (though, DOS applications may also output to this printer if they are configured to recognize the printer type) - the selection of the X Printer is performed using the DESQview/X Setup program.

4.8.3 Print Manager

The Print Manager can be thought of as a traffic officer, directing files to the appropriate printers at specific times or alternatively to the X Print Driver. It is possible for the user to interact with the the Print Manager, list and reorder files in its print queue, suspend and resume printing as well as other operations.

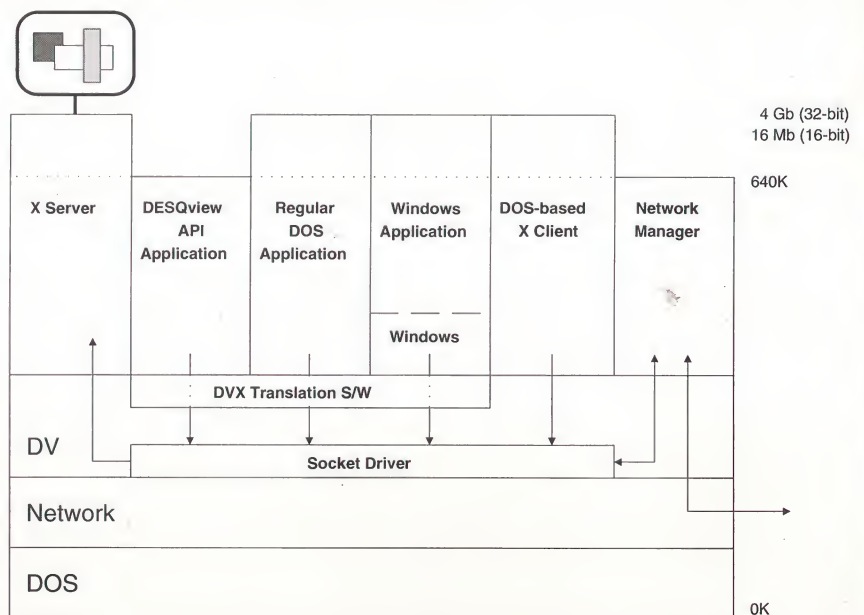
Note, however, that DESQview/X may be configured such that spooling can still occur even if the Print Manager is not present in the system. When the user then starts up the Print Manager, it searches the spool directory for printer control files, produces a resulting print queue and begins printing.

4.9 The Network Connection

When a DESQview/X system is connected to a network, the structure is identical to that of a stand-alone system, but with the inclusion of network software and the DESQview/X Network Manager.

4.9.1 The Network Manager

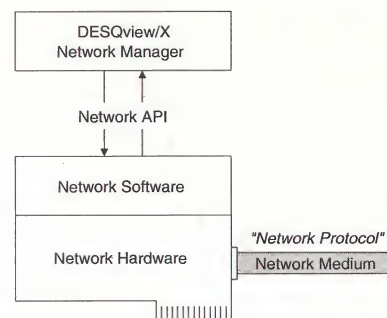
The DESQview/X Network Manager is the bridge between the DESQview/X Socket Driver and the underlying network software. Since PC networks and their supporting network software vary greatly, a different version of the Network Manager is supplied depending on the type of network installed. Currently, the DESQview/X Network Manager can communicate using the following network APIs and network software: NetBIOS, Novell Network IPX/SPX, FTP



Systems PC/TCP, and Novell's LAN WorkPlace for DOS. Check with Quarterdeck Office Systems for an up-to-date list of network APIs/software supported.

Note that there are many pieces in the network puzzle that must be compatible with each other in order for DESQview/X (or any other piece of software) to function over a network.

The DESQview/X Network Manager communicates with the Network Software using a network API. The network software in turn communicates with a piece of network hardware (using the hardware's specific interface) which then sends the network data out over a network medium (usually a cable of some sort) according to a network protocol (a particular format for the data). The examples at right should make this relationship clear.



Because of the tremendous variety available between network software and hardware, Quarterdeck Office Systems cannot publish an exhaustive list of networks supported. Quarterdeck has an ongoing program to support popular network API's/software and will be making them available as soon as they are developed.

API	Software	Hardware	Medium	Protocol
IPX/SPX	Netware (Novell)	NE-2000 Adapter	Ethernet Cable	IPX/SPX
NetBIOS	IBM Token Ring Network (IBM)	IBM Token Ring Adapter/A	Token Ring Cable	NetBIOS
private	PC/TCP (FTP Systems)	NE-1000 Adapter	Ethernet Cable	TCP/IP

Examples of Network Software and Hardware Combinations

4.9.2 Operation over a Network

When an X Client (DOS-based X Client, DOS or Microsoft Windows application translated to X Protocol requests) is started under DESQview/X, a parameter is supplied that specifies which screen the program's output should be displayed on. (This is standard procedure for any X Window System.) If the display specified is not the local DESQview/X screen, the DESQview/X Socket Driver will route the X Protocol requests to the DESQview/X Network Manager. The Network Manager then uses the appropriate network API to transmit the request to the correct machine on the network via the network software. If, on the other hand, the output should appear on the local screen, the Socket Driver will route the X Protocol requests directly to the local X Server as in the case of the stand-alone system.

Conversely, if another machine on the network sends X Protocol requests to the DESQview/X system for display on its screen, the request is first accepted by the Network Manager. The Network Manager will then route the requests to the local X Server via the Socket Driver by using the Berkeley Socket interface.

4.9.3 Communication Ports

Most networks rely on the notion of "ports" when communicating. An application will connect to a port on a remote machine in order to communicate with it. In machines that run the X Window System, TCP/IP or the Unix operating system, several of these ports are "reserved" and imply a special type of connection.

For example, port numbers starting at 6000 are the X Protocol ports (remember that a machine can have multiple X Servers connected to it so that 6000 refers to the first X Server (or "display number" 0), 6001 to the second, etc). Whenever an application connects to port (for example) 6002 on a remote machine and sends a message to it, the receiving machine knows that it is an X Protocol request by virtue of the port number. It is then the receiving machine's duty to dispatch the request to the appropriate X Server (the third X Server, or display number 2, in this case).

Note that there can be multiple connections to a single port. This is because a connection is defined by both the sending machine/port number and the receiving machine/port number. Since most reserved ports do not take into account the number of the sending port, one machine can have multiple connections to another machine's port by choosing different send ports. This is necessary when (for example) multiple applications on one machine connect to the X Server on another.

Other reserved ports imply several other functions - RSH (Remote Shell), REXEC (Remote Exec), FTP (File Transfer Protocol) and Telnet. Unlike the X Protocol port, these 4 other ports typically spawn "daemons" - programs that are invisible to users of the remote machine and execute in the background. DESQview/X supplies daemons for RSH, REXEC and FTP, but not Telnet - see the Telnet section for details.

4.9.4 Remote Shell

A **remote shell** (RSH) is one method for starting up applications on remote (other) machines anywhere on the network. When a user types in an RSH command on one machine, the RSH program connects to the RSH port on the remote machine. At this point, the remote machine (recognizing that the RSH port was connected to), spawns an RSH daemon.

This RSH daemon takes the command supplied in the RSH message and executes it on the remote machine for the user specified in the message, sending any output back to the originating port - typically this output is simply echoed to the screen by the originator's RSH program.

DESQview/X supplies both an RSH daemon to respond to RSH requests as well as an RSH program that can send RSH requests to another machine.

This is a very powerful concept - remember that X Protocol requests produced by an X Client may be routed to any X Server on the network. A user seated at one machine (be it DESQview/X or Unix) may use the remote shell feature to start up an application on another machine, yet have its output appear on the user's local machine (or any other display on the network). The user is now able to operate and use the X Client that is running remotely. X Clients that are run this way are termed remote clients.

Naturally, there are safeguards in the RSH feature that are intended to stop unauthorized access to remote machines, however, they are far from complete. Because of this, the Remote Exec feature was developed.

4.9.5 Remote Exec

The **remote exec** (REXEC) function is very similar to the RSH command except for how it guards against unauthorized access. With REXEC, the user supplies a password that is transmitted along with the REXEC command. If the password is not valid for the user name specified in the message, the command will fail.

DESQview/X supplies both an REXEC daemon to respond to REXEC requests as well as an REXEC program that can send REXEC requests to another machine.

4.9.6 File Transfer Protocol

The **file transfer protocol** (FTP) function is used to transfer files to and from a remote machine, as well as list directories on the remote machine.

The FTP daemon responds to a limited set of english-like commands that specify actions such as listing a directory, changing to another directory and receiving or transmitting a file. The DESQview/X File Manager application uses these capabilities to perform sophisticated file operations between machines. It connects to the remote machine's FTP port and issues the low-level FTP commands to gather information required and transfer files.

DESQview/X supplies an FTP daemon to respond to FTP requests and the DESQview/X Network Manager - DESQview/X to Other X Systems includes an FTP program that can send basic FTP requests to another machine. The FTP program is not included in the base product as the File Manager companion is easier to use and more advanced.

4.9.7 Telnet

The **Telnet** function is used to create a terminal session on a remote machine which is displayed on the local machine. A Telnet request invokes the Telnet daemon, which in turn (typically) starts a "shell" program, such as the login program on most Unix machines. The session then behaves much like a modem communications session - the shell program on the remote machine (and any programs run under the shell) send characters and terminal control sequences which are routed via the Telnet daemon to the Telnet requestor and then to the user's display. In turn, the Telnet requestor will also send characters typed by the user to the Telnet daemon which routes them to the shell program.

Since Telnet was primarily designed for communicating with a TTY-style (line and character-oriented) device, the Telnet daemon has not been implemented for DESQview/X as this would require a program capable of translating DOS screens into TTY-style commands. Instead, a remote machine running the X Window System can use RSH or REXEC to start a DOS session. Note, however, DESQview/X does supply a Telnet client that can start a Telnet session on a remote (non-DESQview/X) machine.

4.9.8 Remote Clients

The remote shell and remote exec functions open up a wealth of possibilities for users connected over a network by spawning **remote clients**. All of the X Clients on an X network can be started up and used by any X Window user on the system.

Since regular DOS and Microsoft Windows application screens can be dynamically converted to X Protocol requests by DESQview/X, DOS and Windows applications appear on a network as X Clients. Because of this, non-DOS users on a network may use DOS and Windows applications available on a DESQview/X machine. Applications that may not be used this way are those which cannot be translated into X Protocol requests on the host DESQview/X system. Currently, those applications are regular DOS graphical applications.

In effect, any DESQview/X machines on a network appear somewhat as Unix machines with their DOS and Microsoft Windows applications running as X Clients.

The converse to the above is also applicable - a networked DESQview /X machine may use X Clients available on other non-DOS machines (for example, a Sun or SCO Unix system.)

4.9.9 Interprocess Communications

Communications between processes is implemented in DESQview /X through the industry standard Berkeley Socket interface - the primary means of IPC communications for Unix machines.

This interface was designed to be totally independent of any underlying network and hence can be used by one process to communicate with another on a different machine across a network, regardless of the type of network (TCP/IP or Novell, for example). In DESQview /X, Berkeley Socket interface calls are accepted by the DESQview /X Socket Driver which routes them to the appropriate destination - whether to another application in the same machine, or to an application on a remote machine by broadcasting the message over a network. This results in the simplified coding of an application as it communicates with both local and remote applications in exactly the same way.

In a similar fashion to the DESQview API mailbox interface, the Berkeley Socket interface does not dictate the content of the message sent to another process, hence any manner of dialog may be implemented between two processes.

4.10 Stand-Alone or Networked?

DESQview /X may be run either as a stand-alone system or networked.

If run as a stand-alone system, applications typically run on the system will be the X Server (for display output), a window manager (to control the windows), multiple DOS and Windows applications and multiple X Clients.

If a DESQview /X machine is networked, the minimum required running is the X Server and Network Manager. The window manager and any X Clients (be they regular X Clients or dynamically translated DOS or Windows applications running on another DESQview /X machine) may all be run remotely on other machines on the network. Usually, some local applications will also be run.

4.10.1 Unix Machines and DOS/Microsoft Windows programs

Assume a network to primarily consist of Unix machines and/or X terminals. If a DESQview /X machine is added to the network that has a powerful processor (such as a 386 or 486), all of the Unix X Window users would then be able to use many of the DOS and Microsoft Windows applications that are available on the DOS (DESQview /X) machine.

4.10.2 DOS Machines and Unix Programs

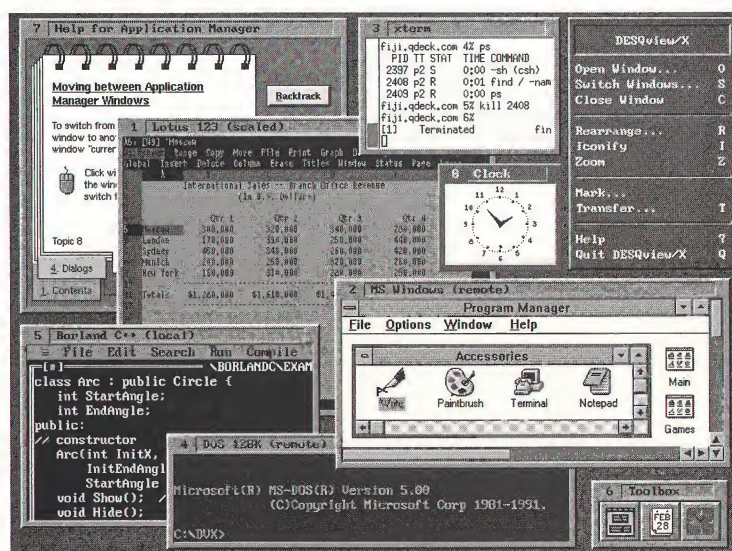
The converse to the above situation is also true. On a DOS-based (DESQview /X) network, the addition of a Unix machine provides the DOS users access to any X Clients on the Unix machine. Large, powerful applications now become feasible that are not available for DOS and which would suffer running under a slower processor. In addition, by using the Xterm application on a Unix machine enables DOS users to access that machine's character-based non-X applications as well.

4.11 A User's View

It is not important to the user whether an application being used is running locally or remotely. It is possible with DESQview /X to hide all of these details, such that a user views a screen much like the one shown.

The screen shot shows a DESQview /X system with the DESQview /X Window Manager. Some applications are labelled "remote" or "local" for illustration purposes only, though a user's implementation of this system may elect not to show this kind of information.

In the picture, DOS 128K (COMMAND.COM) and Borland C++ are DOS applications, one running on a remote DESQview /X machine, the other locally; Lotus 123 is also a local DOS application, but is displayed in a scalable DOS window. Application Manager (labelled "Toolbox"), its Help window and Clock are DOS-based X Clients; Xterm is a remote X Client running on a Sun workstation; and MS Windows is a Microsoft Windows session that is being run on another DESQview /X system, but is displayed locally.



4.12 A Consistent Growth Path

DESQview/X is built on the existing technology of DESQview and DESQview 386 - two time-proven DOS multitaskers that are popular worldwide. Because of this, Quarterdeck can provide users with an excellent and consistent growth path that starts with DESQview:

DESQview	DESQview provides the DOS user with a multitasking environment on machines with as little as 640K, a hard disk, a monochrome monitor and an 8088 processor. DESQview is a character-based environment, but can also run graphics applications. Features include windowing and program swapping as well as a keyboard macro program, a help system, a DOS Services utility and easy-to-use keyboard or mouse control.
DESQview 386	In addition to DESQview's features, DESQview 386 provides the 386/486 DOS user with a multitasking environment that incorporates superior memory handling, windowing features and program protection.
DESQview/X	DESQview/X incorporates the functionality of DESQview and DESQview 386, yet sports a graphical interface that is consistent with the menuing system used by those products. Because of its complete X Window capability, DESQview/X also gives users the capability to run local X Clients as well as access to DOS or Microsoft Windows applications and X Clients on remote machines (using the appropriate network software).
DESQview/X and OSF/Motif, OPEN LOOK Window Managers	When DESQview/X is joined by either the OSF/Motif or an OPEN LOOK window manager, users will have a consistent look and feel across all machines on a network, from DOS machines (DESQview/X) to X Terminals, Unix workstations, minis and mainframes.

4.13 DESQview/X System Capabilities

The capabilities of a DESQview/X system outlined in the preceding sections can be dependent on many factors. Consequently, here is a table of DESQview/X's capabilities:

DESQview/X Capabilities		386 486
Remote X Client, Remote DOS Application or Remote Microsoft Windows and Application		W
Local X Client	Real Mode	W
	16-bit Protected	W
	32-bit Protected	W
Local Well-behaved DOS Text Application or Local Ill-behaved DOS Text Application with Loader	Real Mode	W**
	16-bit Protected	W**
	32-bit Protected	W**
Local Ill-behaved DOS Text Application	Real Mode	W**
	16-bit Protected	WD**
	32-bit Protected	WD**
Local DOS Graphical Application	Real Mode	D
	16-bit Protected	D
	32-bit Protected	D
Local Microsoft Windows 3.0, 3.1 and Windows Application	Real Mode*	W**
	Standard Mode	W**
W Application can be displayed in an X window and can act as a remote X Client for another X Server on a network. D Application can only be displayed direct and cannot act as a remote X Client for another X Server on a network. WD Dependent on individual application - most run as W, some may run as D. - Processor cannot support this type of application. * Available only with Microsoft Windows version 3.0. ** Application may be run as a direct window (full screen) for fastest performance.		

5 Development Issues

This section outlines the development procedures for the different program types that DESQview/X supports and examines how these relate to the development of X Clients under DESQview/X.

DESQview/X supports the following kinds of applications: DOS text (regular DOS applications), DOS graphical (regular DOS graphical applications), DESQview API, Microsoft Windows and of course, X Clients. Most of these application types can appear as either real mode, 16-bit protected or 32-bit protected.

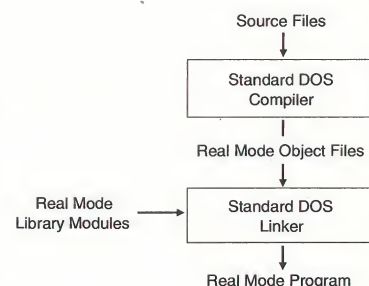
5.1 Real Mode Applications Development

In order to generate a real mode application, a developer will follow the traditional steps to produce an application:

First, all necessary source files are compiled using a regular DOS compiler to create real mode object files. Next, a regular DOS linker is used to link those object files with real mode library modules to produce a runnable application.

Often the compiler, linker and library modules are supplied by a single manufacturer as a complete package.

Library modules are available (sometimes from third party manufacturers) with graphic routines to produce a graphical application or Microsoft Windows routines to produce a Windows application.



5.2 Protected Mode Applications Development

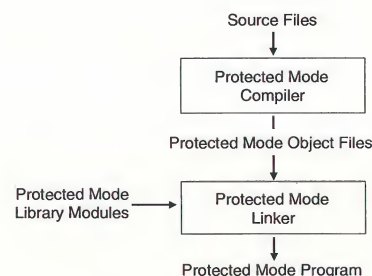
To generate a protected mode application for DOS, a developer will require the use of a DOS Extender package and normally follows one of two paths.

5.2.1 Using a Protected Mode Compiler and Linker

If a protected mode compiler is used, it will generate protected mode object files. (Note that the words "protected mode" in the name "protected mode compiler" are referring to the kind of output the compiler generates, not the kind of program the compiler may be - it could actually be a real mode program or a protected mode program running under a DOS Extender!)

These protected mode object files are then linked with protected mode library files and DOS Extender modules to create a protected mode application that is runnable from DOS.

Typically the compiler, linker and library modules are supplied by a single manufacturer as a complete package.



- If a 16-bit protected mode application is required, then a compiler and linker capable of handling 16-bit protected code must be used as should 16-bit protected library modules.
- For a 32-bit protected mode application, a compiler and linker capable of handling 32-bit protected code must be used as should 32-bit protected library modules.

As in the case of real mode applications, library modules are available (sometimes from third party manufacturers) with graphic routines to produce a graphical application or Microsoft Windows routines to produce a Windows application.

Note that a trend in protected mode compilers is to offer a DOS Extender as part of the compiler package, obviating the need to choose and purchase a DOS Extender separately.

Previously, there was not as big a selection of 16-bit and 32-bit protected mode development packages as there are today. To address this situation, many DOS Extender manufacturers supply an alternate route: using regular DOS compilers.

5.2.2 Using a Regular DOS Compiler

If a regular DOS compiler is used, this will create real mode object files. This may seem inconsistent, however real mode is very similar to 16-bit protected mode code, save for a few constraints. Note that if generating code for a 32-bit environment, using a regular (16-bit) DOS compiler will result in code that will not take advantage of the 32-bit architecture of the processor.

At this point either a regular DOS linker or a protected mode linker may be used. Whatever linker is used, it will typically link in real mode library routines and some protected mode modules as well in addition to the DOS Extender modules. The real mode library routines are ones supplied by the regular DOS compiler manufacturer that do not violate protected

mode guidelines and hence may be used in a protected mode environment. Any library modules that do violate those guidelines are replaced by modules that have been rewritten by the DOS Extender manufacturers and are linked in as protected mode modules.

Sometimes it may be necessary to run a conversion program after the linking stage to create the final protected mode program.

Note that a need for protected mode linkers has become apparent because many regular DOS linkers have certain limitations when creating protected mode programs (since they were not designed to produce these kinds of programs).

5.2.3 DOS Extenders

In order for a protected mode application to run under DOS (or DESQview/X) it requires the use of a DOS Extender. A third-party DOS Extender may be used, though many compilers now supply their own DOS Extender and protected mode libraries. DESQview/X includes the DOS/4GX DOS Extender and the DESQview/X Development Kits (see later) supply the necessary protected mode libraries.

5.3 X Client Development for DESQview/X

Developing or porting X Clients to the DESQview/X platform requires a developer to follow the general steps outlined in the previous section.

Depending on the size of the resultant X Client, a developer will create either a real mode, 16-bit protected mode or 32-bit protected mode application. Typically, X Clients that are ported from another environment (usually Unix) will be implemented the easiest as a 32-bit protected mode application.

In order to create an X Client as opposed to a regular DOS or DOS Extended application, the X Client object files are linked with Xlib and/or Toolkit function libraries in addition to the usual program libraries.

5.3.1 DESQview/X Development Kits

The development kits that are (or will be) available for the development of X Clients in DESQview/X are:

X11	includes XLIB, Xt Intrinsics, Athena Toolkit and sample X Clients.
OSF/Motif	add on to X11 Toolkit
OPEN LOOK	add on to X11 Toolkit

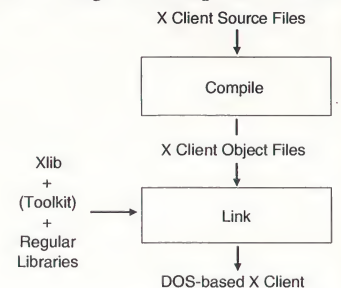
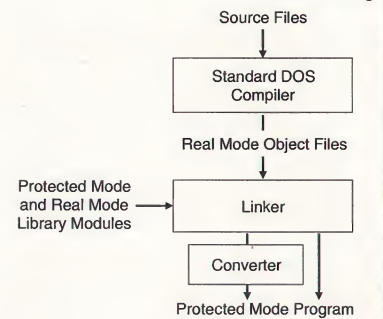
Each development toolkit includes different versions of the program libraries for use by particular compilers. The versions that are (or will be) available include:

Library	Real Mode	16-bit Protected	32-bit Protected
X11	B,M,Z	B,IC,M,Z	G,HiC,W
OSF/Motif	-	?	?
OPEN LOOK	-	?	?
B	Borland C/C++ 3.1	M	Microsoft C version 5.1 or 6.x
G	GNU C/C++	W	Watcom C/386 9.0
HiC	Metaware High C 1.7 or 3.0	Z	Zortech C/C++ 3.0
IC	Rational Systems Instant-C	?	Not determined yet

This table is by no means exhaustive and is expected to change - check with Quarterdeck Office Systems for a list of compilers/program modes currently supported.

5.3.2 DOS/4GX Support

Because DESQview/X contains DOS/4GX DOS Extender technology, a separate DOS Extender is not required for use with the DESQview/X Development Kits. Compilers supported by the DESQview/X Development Kits produce code that is compatible with the DOS/4GX support.



OSF/Motif and OPEN LOOK libraries will not be supplied for use by real mode applications due to the size of their libraries.

Rational Instant-C is of interest in that it is an incremental compiler - it recompiles functions as they are changed to provide a fast development environment much like interpreted BASIC. For final code, however, a program should then be compiled with a fully-optimizing compiler such as Microsoft C.

6 DESQview/X Products

There are several products available in the DESQview/X suite of system software - base products, additional window managers, development kits and additional network manager product.

Contact Quarterdeck Office Systems Customer Service at (800) 354-3222 for a complete list of products and services offered as well as current list prices.

DESQview/X (for 386 PCs)

This product enables a single user to implement on a 386 processor (or better), the DESQview/X graphical environment system for running DOS, Microsoft Windows and/or DOS-based X Clients. In addition, remote computing facilities are provided so that the DESQview/X system can interact with other DESQview/X systems using either a Novell (IPX/SPX) or NetBIOS network. Specifically, a DESQview/X system may use remote DOS, Microsoft Windows or DOS-based X Clients on other DESQview/X systems as well as being able to transfer files.

It includes QEMM-386, Quarterdeck Manifest, the X Server product, the DESQview/X Window Manager (DWM), several graphical utilities (the DESQview/X Companions - Application Manager, File Manager, Icon Editor and Adobe Type Manager) and support software such as a Print Manager and DESQview/X to DESQview/X Network Manager for IPX/SPX and NetBIOS.

OSF/Motif Window Manager

An addition to the DESQview/X base product, the OSF/Motif Window Manager replaces the default DWM window manager to sport an OSF/Motif look and feel.

OPEN LOOK Window Manager

An addition to the DESQview/X base product, the OPEN LOOK Window Manager replaces the default DWM window manager to sport an OPEN LOOK style interface.

DESQview/X Network Manager - DESQview/X to Other X Systems

This network software product is an addition to the DESQview/X base product and enables a DESQview/X system to communicate with other X machines (DESQview/X or otherwise) over a variety of networks. Note that the DESQview/X base product includes support for NetBIOS and IPX/SPX (Novell) networks - this additional package delivers support for other network APIs such as PC/TCP (FTP Systems) and LAN WorkPlace for DOS (Novell) and includes a coupon for a free copy of Novell's TCP/IP Kernel for DOS. Since this list may change, check with Quarterdeck Office Systems for an up-to-date list of network APIs that DESQview/X supports.

Note that this package permits a DESQview/X system to communicate with other DESQview/X and X Window machines over a network. It is not a substitute for and does not replace the standard network software that is required to form a network.

DESQview/X X11 Toolkit

The DESQview/X X11 Toolkit enables developers to port existing X Clients to the DESQview/X platform or create new ones. This kit contains the X11 program libraries for all supported compilers (Xlib, the Xt Intrinsics, the Athena Toolkit) and sample X Clients. In addition, the kit includes the DOS/4GX Extender tools, Rational System's Instant-C and Oxygen utility, full printed documentation, and developer support from Quarterdeck Office Systems.

Check with Quarterdeck Office Systems for a list of compilers/program modes currently supported for this and other development kits.

DESQview/X X11 Library Kit

The DESQview/X X11 Library Kit is a less expensive version of the DESQview/X X11 Toolkit that does not include Rational System's Instant-C and Oxygen utility. In addition it only includes standard 90-day end user support from QOS.

DESQview/X X11 Starter Kit

The DESQview/X X11 Starter Kit consists of the GNU C/C++ compiler and GNU versions of the DESQview/X X11 Libraries (Xlib, Xt Intrinsics and Athena Widgets). In addition, minimal printed documentation is included that describes compiling X Clients as well as specific details on programming and configuring the DESQview/X environment. No documentation regarding generic X Window programming is supplied with this kit.

Even though this kit does not include the DOS/4GX Extender tools, 32-bit protected mode applications may be developed as the GNU compiler includes its own DOS Extender.

This kit is provided at a very competitive and inexpensive price and only includes standard 90-day end user support from QOS.

DESQview/X OSF/Motif Toolkit

An addition to the DESQview/X X11 development kits, the OSF/Motif Toolkit enables developers to create applications with an OSF/Motif look and feel. It consists of the OSF/Motif program libraries, the DESQview/X OSF/Motif Window Manager, Motif and DESQview/X Programming manuals at a very attractive price.

Check with Quarterdeck Office Systems for a list of compilers/program modes currently supported for this development kit.

DESQview/X Developer Passport Support

DESQview/X Developer Passport Support (included only with the DESQview/X X11 Toolkit and available separately) provides a year of special access to DESQview/X development support technicians and to the DESQview/X porting laboratories. The porting laboratories offer individual personalized assistance when porting to the DESQview/X platform or creating new DESQview/X applications. Two locations currently exist - Santa Monica, California and Chelmsford, England with more planned.

Note that many components of the DESQview/X Development Kits (including developer support) are available separately - please contact Quarterdeck Office Systems for a complete list of products/services and current list prices.

FREE EVALUATION DEVELOPMENT KIT

DESQview/X X11 Libraries for GNU C/C++

The GNU C/C++ versions of the DESQview/X X11 Libraries (Xlib, Xt Intrinsics and Athena Widgets) are available on Internet (anonymous ftp server barnacle.erc.clarkson.edu, qddvx100.zip file (note '100' denotes version 1.00 - this can change) in directory /pub/msdos/djgpp) and from the Quarterdeck Office System BBS ((310) 314-3227). Note that the GNU C/C++ compiler is also available from Internet and the QOS BBS.

Even though this libraries do not include the DOS/4GX Extender tools, 32-bit protected mode applications may be developed as the GNU compiler includes its own DOS Extender.

These libraries are offered free of charge, but include no documentation or support from QOS.

Internet Downloading Instructions

FTP users:

```
File location:
  host:      barnacle.erc.clarkson.edu
  login:     ftp
  password:  <your email address>
  directory: ~ftp/pub/msdos/djgpp
```

Non-FTP users:

```
% mail archive-server@barnacle.erc.clarkson.edu
Subject: <none>
help
index msdos/djgpp
<ctrl-D>
```


TRADEMARKS

DESQ[®], *DESQview*, *DESQview/X*, *Application Manager*, *DESQview/X File Manager*, *DESQview/X Icon Editor*, *Quarterdeck Expanded Memory Manager-386*, *QEMM-386*, *Quarterdeck Manifest*, *Manifest*, *Quarterdeck QRAM*, *GRAM*, *Quarterdeck Expanded Memory Manager 50/60* and *QEMM 50/60* are trademarks of Quarterdeck Office Systems, Inc.

Adobe Type Manager, *ATM*, *Postscript* and *Adobe* are trademarks or registered trademarks of Adobe Systems Incorporated. *AT&T* and *OPEN LOOK* are trademarks or registered trademarks of AT&T. *AutoCAD* is a registered trademark of Autodesk, Inc. *Clipper* is a registered trademark of Computer Associates International, Inc. *DEC* is a registered trademark of Digital Equipment Corporation. *DGIS* is a registered trademark of Graphic Software Systems, Inc. *DOS/4G*, *DOS/4GX* and *Instant-C* are trademarks of Rational Systems, Inc. *FrameMaker* is a registered trademark of Frame Technology Corporation. *Helvetica* and *Times Roman* are trademarks of Linotype AG and/or its subsidiaries. *High C* is a registered trademark of MetaWare Incorporated. *IBM*, *PC*, *PC-DOS*, *Presentation Manager*, *NetBIOS* and *OS/2* are trademarks or registered trademarks of International Business Machines Corporation. *Intel*, *386* and *486* are trademarks of Intel Corporation. *Lotus* and *1-2-3* are registered trademarks of Lotus Development Corporation. *Macintosh* is a registered trademark of Apple Computer, Inc. *Microsoft*, *MS*, *MS-DOS*, *XMS*, *Word* and *Microsoft Windows* are trademarks or registered trademarks of Microsoft Corporation. *Novell*, *Netware*, *DR DOS*, *GEM* and *LAN WorkPlace for DOS* are trademarks or registered trademarks of *Novell, Inc.* *OSF/Motif*, *OSF* and *Open Software Foundation* are trademarks of the Open Software Foundation, Inc. *Paradox*, *Dbase* and *Borland C++* are trademarks or registered trademarks of Borland International, Inc. *PC/TCP* and *FTP Software* are trademarks or registered trademarks of FTP Software, Inc. *SunView* is a trademark of Sun Microsystems, Inc. *Unix* is a registered trademark of AT&T in the U.S. and other countries. *Ventura Publisher* is a trademark of Xerox Corporation. *Watcom C* is a trademark of Watcom, Inc. *WordPerfect* is a registered trademark of WordPerfect Corporation. *X Window System* is a trademark of the Massachusetts Institute of Technology. *Zortech* is a trademark of Symantec Corporation. Other brand or product names are trademarks or registered trademarks of their respective holders.

COPYRIGHT

This document describes software that is copyrighted and all rights reserved by Quarterdeck Office Systems. Portions of the software are copyrighted by Adobe Systems Incorporated, Graphics Software Systems, Inc., Massachusetts Institute of Technology, Microsoft Corporation, Rational Systems, Inc.

This document is copyrighted and all rights reserved. This document may not, in whole or part, be copied, photocopied, reproduced, translated, or reduced to any electronic medium or machine readable form without prior consent, in writing, from Quarterdeck Office Systems.

(c) 1985-1992 Quarterdeck Office Systems, Inc.
1901 Main Street, Santa Monica, CA 90405 (310) 392-9701

All Rights Reserved
U.S. Patent No. 4,125,873; Patent pending.

U.S. GOVERNMENT RESTRICTED RIGHTS

If this product is acquired under the terms of a DoD contract: Use, duplication or disclosure by the Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of 252.227-7013. Civilian agency contract: Use, reproduction or disclosure is subject to 52.227-19 (a) through (d) and restrictions set forth in the accompanying end user agreement. Unpublished-rights reserved under the copyright laws of the United States. Quarterdeck Office Systems, Inc., 1901 Main Street, Santa Monica, CA 90405.

CREDITS

Writer: Mark Radcliffe
Cover design: Cynthia Ford
Production notes: This document was created electronically using Ventura Professional.



Raising DOS to the Power of X™

DESQview/X Application Manager, for organizing programs and projects

Comfortable DESQview look and feel for BOTH keyboard and mouse users

DOS and Windows applications compatibility

Multitasking

Award winning memory management with Manifest and QEMM-386

Scalable fonts and scalable DOS windows thanks to Adobe Type Manager™ for DESQview/X

Built-in X Window System graphics, the international standard for graphical windowing and distributed computing

DESQview/X File Manager for managing files on your PC and on remote systems

DESQview/X takes your 386 or i486 computer where it has never gone before. Beyond mere windowing, beyond ordinary graphical interfaces. With DESQview/X your computer is no longer limited to the power of your PC and DOS applications.

DESQview/X brings you the windowing, multitasking, DOS and Microsoft Windows compatibility, data transfer, and key-stroke macro facilities, that you would expect from Quarterdeck, the leader in DOS multitasking. With the addition of X Window System graphics, Adobe Type Manager™ for scalable fonts and scalable DOS windows, a graphic desktop, customized menus and icons, and remote computing, DESQview/X redefines the limits of personal computing.

Technical Support: 310/392-9701 Fax: 310/314-3217

Trademarks are property of their respective owners. © 1992 Quarterdeck, Inc. All rights reserved.

Quarterdeck Office Systems, Inc.
150 Pico Boulevard
Santa Monica, California 90405
310/392-9851 Fax: 310/314-4217

Quarterdeck Office Systems Canada, Inc.
70 York Street, Suite 1220
Toronto, ONT, Canada M5J 1S9
416/360-5758 Fax 416/360-4885

Quarterdeck Office Systems (Middle East), Ltd.
1 Souliou Street, Suite 103
Strovolos, Nicosia, Cyprus
352 2 311 630 Fax 352 2 311 560

Quarterdeck Office Systems, GmbH
Willstätter Strasse 15
D-4000 Düsseldorf 11, Germany
49 211 59 79 00 Fax 49 211 59 41 26

Quarterdeck Office Systems, S.a.r.l.
4 Rue du General Lanrezac
75017 Paris, France
33 1 44 09 03 91 Fax 33 1 44 09 03 47

Quarterdeck Office Systems España, SA
G.V. de Les Corts Catalanes, 617, 1º - 3a
08007 Barcelona, Spain
34 3 412 29 45 Fax 34 3 412 44 41

Quarterdeck Office Systems, UK Ltd.
The Widford Hall, Widford Hall Lane
Chelmsford, Essex
United Kingdom CM2 8TD
44 245 496699 Fax 44 245 495284

Quarterdeck International Ltd.
BIM House, Crofton Terrace
Dun Laoghaire, Co. Dublin, Ireland
353 1 2841 444 Fax 353 1 2844 380

Quarterdeck Office Systems, PTY., LTD
37 Sydney St.
Marrickville NSW 2204 Australia
61 (2) 328 6653 Fax: 61 (2) 328 6672

The Information Theater

You've never seen your data quite like this before

MARK A. CLARKSON

The promise of the information age is instant access to the sum of human knowledge from anywhere, at any time. The reality is vast numbers of disconnected databases, each with its own search engine, procedures, and classification scheme. Nothing is more frustrating than knowing that the information you need is out there and having no way to retrieve it.

Retrieving the information you want—and only the information you want—is the focus of an exciting research project at the Xerox PARC (Palo Alto Research Center). The result, called the Information Theater, combines a novel interface with search-and-retrieval technologies to create an information system that brings the promise of the information age closer to reality.

Roots

The notion of the Information Theater was born out of the Interactive Information Access project at Xerox PARC. The Information Theater is about text. It exploits PARC's strengths in user-interface design and natural-language processing to develop new ways of organizing and presenting text on a computer. The results transform database searches and text retrieval into a kind of interactive TV show—with a heavy emphasis on real-time computer animation.

The Information Theater calls on the work of PARC's User Interface Research Group on Information Visualizers (see "An Easier Interface," February 1991 BYTE), which enable databases to appear as physical, 3-D structures that can stretch, slide, and spin in the air (see photos 1 and 2). Information Visualizers use familiar perceptual cues, such as light and shadow, to draw you into their artificial, animated reality. You can see your information, touch it, and rearrange it, achieving a deeper, almost tactile understanding of its structure.

Information Visualizers exemplify the Information Theater's high-bandwidth interaction. This interaction requires high-speed computers, sophisticated graphics, and whole new user interfaces and paradigms. To be effective, the Information Theater has to be more than engaging—it has to be fast. Speed is crucial to maintain the illusion of seamless animation and to make the indexing and searching of large databases quicker. Even if you are merging and sorting a couple of encyclopedias, you don't want to wait forever.

People and Machines

The Information Theater doesn't try to replace human intelligence. Rather, it applies intelligence in ways that seek to



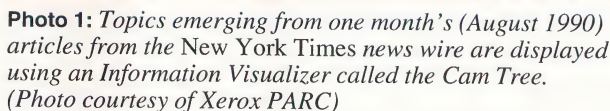


Photo 1: *Topics emerging from one month's (August 1990) articles from the New York Times news wire are displayed using an Information Visualizer called the Cam Tree. (Photo courtesy of Xerox PARC)*

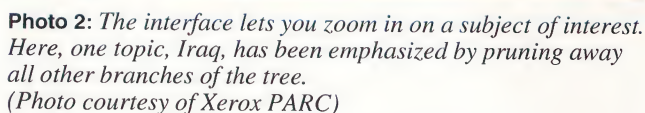


Photo 2: *The interface lets you zoom in on a subject of interest. Here, one topic, Iraq, has been emphasized by pruning away all other branches of the tree.*
(Photo courtesy of Xerox PARC)

Per-Kristian Halvorsen, head of the project's NLTT (Natural Language Theory and Technology) group, says, "An information search-and-retrieval system is most effective if it is viewed as a team consisting of the machine and the user." Each member of the team performs those tasks best suited to him, her, or it: A fast computer is ideal for tasks such as computing the angle between two vectors, each with 10,000 dimensions; you are best suited to understanding your E-mail messages.

Theater Foundations

The Information Theater needs a flexible foundation to support research into different information search-and-retrieval systems. The Text Database supplies this flexibility. It is an object-oriented, modular system written in Common Lisp. You can plug in different modules (e.g., search engines, user interfaces, and natural-language analyzers) as you can with Nintendo games.

and *banked* might all be reduced to *bank*.

Queries and Indexes

Inverted indexes are just what the doctor ordered for Boolean search engines featuring queries like “find me all documents containing *terrorist* and *bombing*.” You can look up the terms *terrorist* and *bombing* in the index and see what documents they both occur in.

Beyond Boolean

One strategy supported by the AI community is to build computer programs that handle all this information for you—

Real Stats. Real Easy.

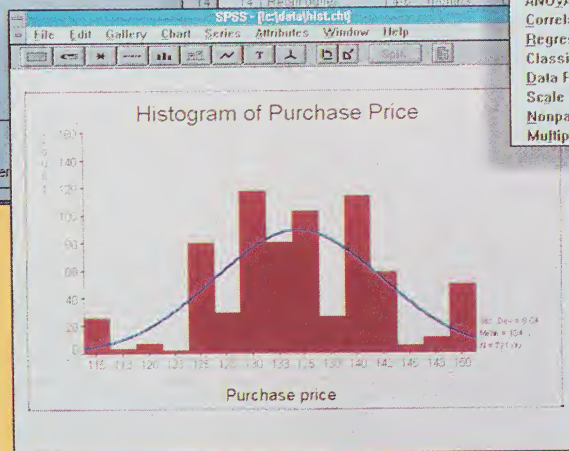
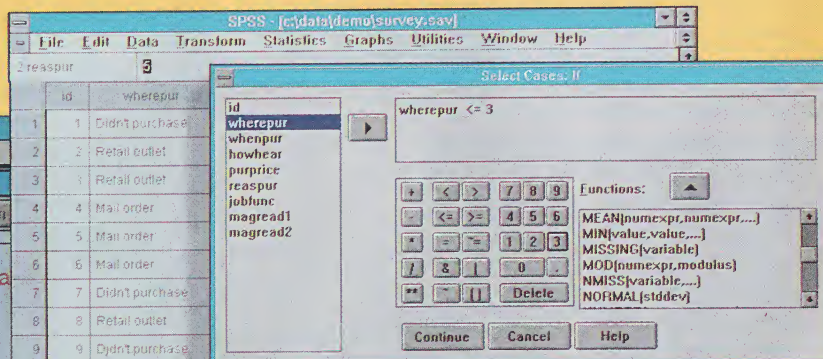
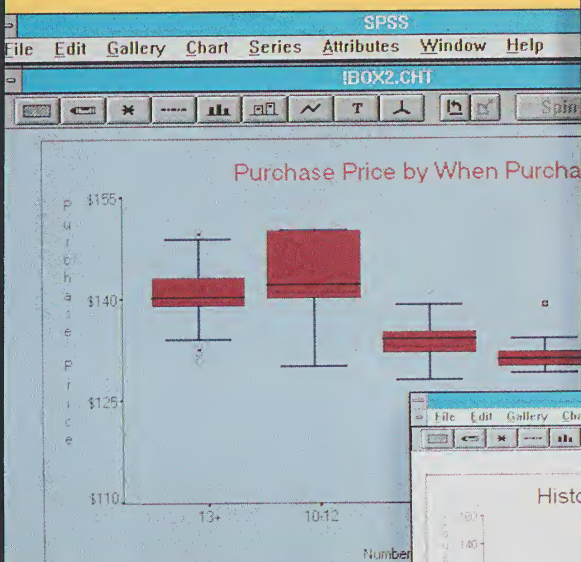
Answer Your Really Tough Questions with SPSS for Windows.

Learn Fast, Work Fast

"It's extremely easy to learn and use. With just the little bit of Windows experience I have, I got through without touching the manual." – John J. Kalamarides, Greenwich Associates. The 100% Windows interface makes doing analysis simple. Hypertext help and an on-line glossary of statistical terms are just a click away.

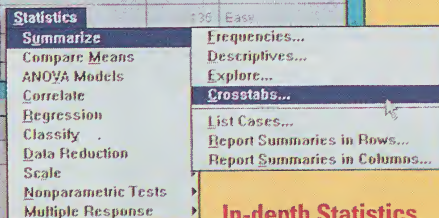
Complete Data Management and Editing

"The data management capabilities are excellent – even better than dBASE" – William O'Hara, Ph.D., Patrick Associates. Enter data or read it directly from Excel, Lotus, dBASE and SQL databases, then edit it and use it many ways – easily.



Automatic Statistical Graphics

"The graphics are superb. Integrating the charting capabilities directly into the statistical procedures was a brilliant move." – Zvia Segal Naphtali, Resource Mobilization Inc. Create statistical charts like histograms, boxplots and scatterplots automatically; there's no relabeling or respecifying.



In-depth Statistics

"I haven't run into a statistical calculation I needed that I couldn't find." – Thomas W. Gruen, CBA Service Corp. Use correlations, crosstabs, regression and more. You won't grow out of this package.

What factors influence purchases? Is service quality high? Are dosage levels optimal? You need answers you can be confident in. But, you can't do in-depth analysis with your spreadsheet or database – they only give you simple sums and percentages.

Don't stay locked in a spreadsheet cell. Break out with SPSS® for Windows™. Subset, sample, aggregate, explore, summarize, poke, prod, slice and dice your data to get the answers you need. Analyze surveys, dig into databases, improve quality, conduct research studies, forecast sales and prepare reports with ease. All without writing complex macros or queries. Find relationships, see patterns and trends, determine significance and use the past to predict the future.

Learn fast, work fast. Prepare for your analysis quickly with SPSS' full-featured Data Editor. Choose from a broad range of statistical routines that produce full-color charts automatically. Hot button between charts and related numerical output. Share information using DDE and OLE. Put together a great presentation with our business graphics, reports and tables. If you need help, the documentation is full of statistical "how to," and experienced technical support is just a phone call away.

For a limited time, you can get answers to your really tough questions at a really special price.

Call 1(800) 543-5835 now for details.

Chicago • Washington, DC • Chertsey, UK • Gorinchem, The Netherlands • Munich • New Delhi • Singapore • Stockholm • Sydney • Tokyo • And Distributors Worldwide



SPSS

so-called intelligent agents. While great in theory, agents have yet to make a dent in the real world. For now, you have to carry out your own searches.

Searching a database is not an easy task. The designer of a document-search program typically focuses on the problem of finding the documents that match your query. The search program assumes it will receive a good query and leaves it up to you to formulate one.

Pedersen believes that this approach is overlooking something fundamental. "We think the problem is a lot harder—and a lot more interesting—than that," he says. "There's another major issue: How do you get a good query?"

Indeed, how do you formulate a good query? How do you know in advance just what words to use or what words are even relevant? What do you do when different professions and nations use different vocabularies to talk about the same things (e.g., bruises/contusions and cosmonauts/astronauts)?

Some words are too common; others, too rare. Consequently, Boolean search schemes are notorious for returning too many or too few documents. A search for documents about *a* and *b* might return 3000 articles—too many to consider. You are faced with reformulating your query, and the system offers you no more help. Narrow the search by looking for documents containing *a*, *b*, and *c*, and you might get back only two or three hits—too few. What now? Do you search for just *a* and *c*? Or would it be better to look for *a*, *b*, and *d*? To make matters worse, if this is your first time using a database, you may not know what documents are available or what words you might use to describe a given subject.

Query by Snippet

In contrast to a standard Boolean search engine, the Text Database contains a module called the Snippet Browser that actively assists you in homing in on the documents you're interested in. In the Snippet Browser, you type in a word or words you're interested in. The program shows you snippets of text (i.e., sentence fragments)

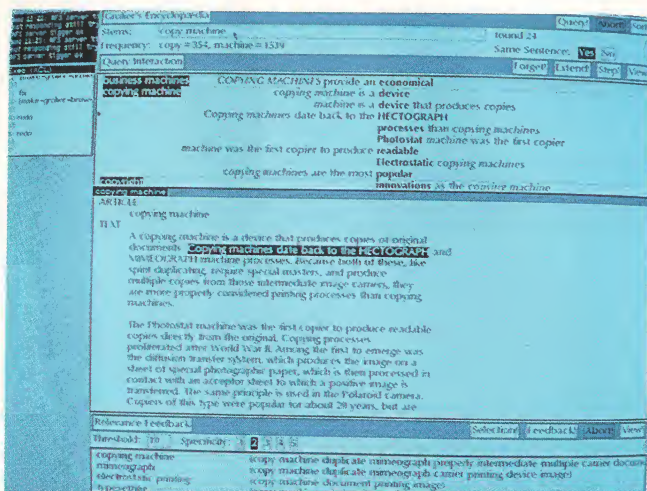


Photo 3: The Text Browser supports two types of search: snippet search and similarity search. The top of the screen shows sentence fragments returned by a snippet search. The middle section is a viewed document with the snippet highlighted. The bottom section contains results from a similarity search. (Photo courtesy of Xerox PARC)

Information Theater Features

- 3-D views of text databases
- Snippet searches
- Similarity searches
- Scatter/gather by topics

containing those words so you can see how your words are used in a given document.

Snippets from a search on the word *computer* might include "...computer industry's largest vendors...", "...the computer graphics...", and "...computer-aided manufacturing..." Because you are searching for documents containing the word *computer*, it comes as no surprise that these snippets do, in fact, contain it.

The Snippet Browser does not highlight the words that were in the query (e.g., *computer*), but instead the flanking words (e.g., *vendors* and *graphics*) that help you establish the context in which the words were used.

Why just snippets, as opposed to titles or paragraphs? In the latter case, the fewer the words, the faster you can leaf through the returning hits and zero in on your target. In the former case, titles are short but often ambiguous, contends Cutting. "If you get a title back, it's not always clear how the words in your query might have been used in the document," he notes. Instead, the Text Database shows where your search target is used and what other words are nearby, which might help to disambiguate its usage. It may suggest some other search terms to you, but it's up to you to figure out if the terms you've used are good or bad. As Cutting puts it, "Sometimes we describe using the Snippet Browser as 'searching for a query.'"

You can see this at work in searching for the word *computer*. At first, you get thousands of hits, and you're not much closer to your target. There is a myriad of different contexts in which *computer* appears. But as these hits show up on your screen in the form of sentence fragments, you can immediately begin selecting the ones that interest you (e.g., computerized drafting) and then marking the ones that don't (e.g., computers in the classroom). Inappropriate documents disappear from the screen. Behind the scenes, the Snippet Browser updates your query on the fly, homing in on documents you find interesting. You can expand the snippets, which gives you more of the context in which they appear, or view any of the documents that catch your interest.

Like a Boolean search, the Snippet Browser relies on an inverted index to locate documents containing your search words. Indeed, under the hood, the Snippet Browser is essentially a constrained version of a Boolean search. The difference is in the user interface. You never confront anything resembling a typical search language. Instead, you select certain uses of a word as interesting, others as not, and iteratively narrow the search to include only the documents you need (see photo 3).

Relevant Questions

The Text Database also offers a similarity search to help you retrieve the documents you need. In a similarity search, documents are compared on the basis of the words they have in common. If you have a document in-hand, a similarity search will find other documents on similar subjects.

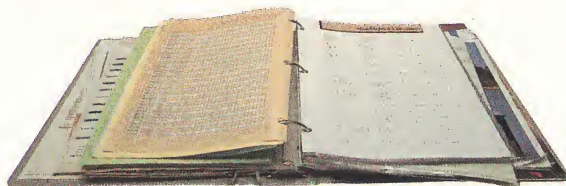
In the Text Database, each document is rendered as a vector (i.e., a line) in a special high-dimensional document space. This space has one dimension for each unique term in the document collection. In *Grollier's Encyclopedia*, which uses around 100,000 unique words, each article would be rendered as a vector in a 100,000-dimensional space. On the other hand, a collection of Dr. Seuss children's books might require only a 1000-dimensional space.

The Text Database estimates the similarity of documents by computing the distance between their vectors. The closer two vectors are to one another, the more similar the documents are presumed to be. "If the words you use had nothing to do with what

If you need to communicate something clearly,
say it more than once,



say it more than once,



say it more than once.



Say it with Multimedia. Say it with Bravado.™



Truevision Bravado is the multimedia engine that lets you multiply ideas. Add and control live video and audio. Merge VGA text and graphics. Repeat your message with power. If you're ready for people to get the message, clearly, what you need is Truevision Bravado.

For more information about Truevision and Bravado, CALL 1-800-344-TRUE.



When it comes to video, it comes from Truevision.™



7340 Shadeland Station, Indianapolis, IN 46256

INTERNATIONAL: Brazil 55-192-329-956 Canada 416/940-8727 France 33-1-3-952-6253 Spain 34-1-563-0282

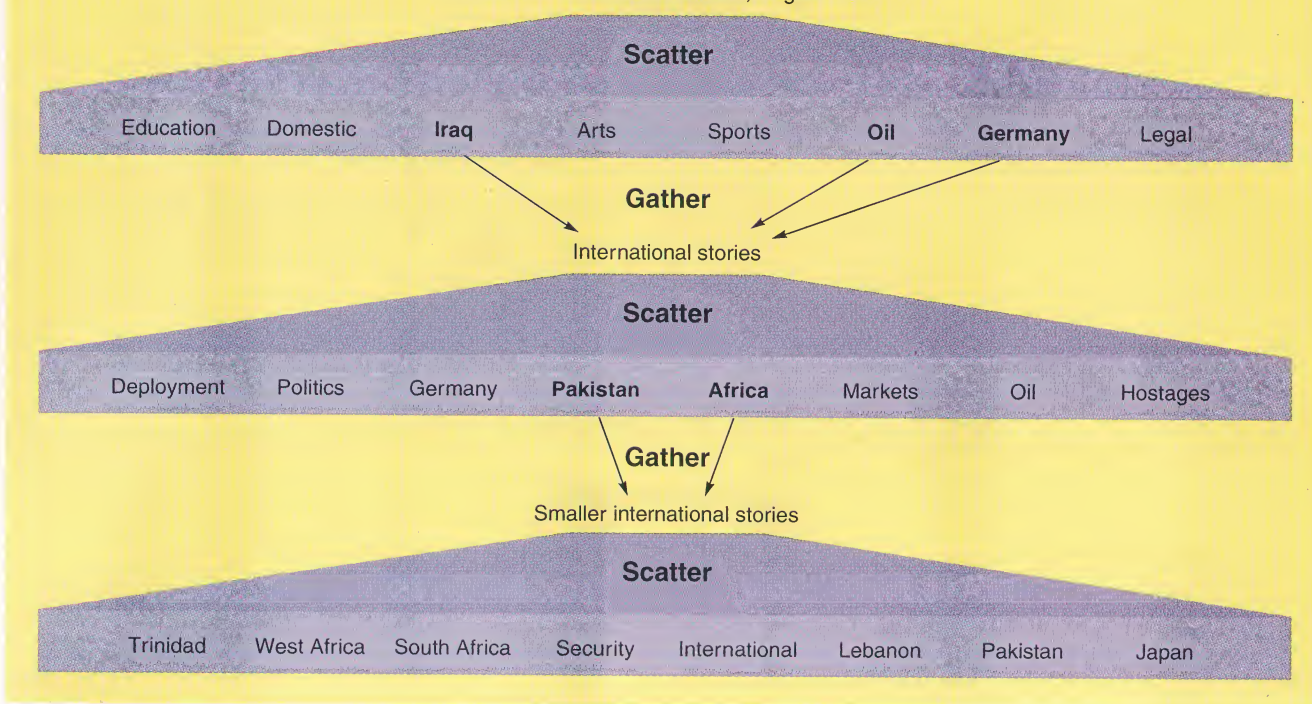
Italy 39-2-242-4551 U.K. 44-628-77-7800 Germany 49-89-612-0010 Other International 617 / 229-6900

© 1992, Truevision, Inc.

Circle 209 on Inquiry Card (RESELLERS: 210).

THE SCATTER/GATHER PROCESS

New York Times news service, August 1990



In the scatter/gather process, a collection of documents—in this case, articles from the New York Times news service—is scattered or broken up into topics. Some of the resulting topics (e.g., Iraq, Oil, and Germany) are gathered together, forming a smaller, more focused document collection, which is scattered again into new topics. You can iterate this process as often as you wish. (Figure courtesy of Xerox PARC)

you were talking about,” says Halvorsen, “this would not work. But since, typically, the words you use correspond in some way to what you’re talking about, this does work. It can tell you whether two documents talk about related matters.”

A natural-language query, such as “find me articles about copy machines,” is also converted into a vector in this document space. The documents closest to the vector—those containing lots of references to both *copy* and *machine*—are returned.

When the similarity search returns documents, you may select one or more of them as relevant. These selected documents become the new query vector, and the documents that are closest to it are returned. Again, the similarity search lets you iteratively approach your target, without encountering a conventional search language.

Calculating Distances

Calculating which documents lie close together seems simple enough, but in practice, it can be complicated; for example, *Grolier's Encyclopedia* contains about 30,000 articles. Comparing each document with every other document requires almost 450 million vector-to-vector comparisons, and each of these vectors contains 100,000 elements—one for every unique word in the encyclopedia. This relationship between the number of documents in the collection and the number of possible comparisons between them is quadratic: Double the number of documents in the collection, and the number of comparisons between them increases fourfold.

This quickly gets out of hand with increasingly large docu-

ment collections. The Text Database avoids this labor-intensive document-to-document comparison by using the statistician's old trick: the random sample.

Using an algorithm called Shotgun, the Text Database selects a representative sample of documents for extensive comparison. For example, such a search of *Grolier's* 30,000 articles might call for a sample of only 574 articles. These require a comparatively manageable 164,000 vector-to-vector comparisons. Moreover, the number of comparisons increases linearly, not quadratically, as the document base increases.

Because of the nature of sampling, a few documents might be misfiled, although not enough to make any significant difference. If you require higher precision, more precise—and slower—algorithms can perform the analysis off-line.

Scattering and Gathering

When documents are plotted as vectors in document space, those documents that use many of the same words will lie close to each other. They appear to be *clustering*. Until now, clustering has been used mostly as a tool to try to improve similarity searches. In contrast, the Interactive Information Access project is exploring clustering as a means to navigate through large or strange document collections.

At the broadest level, clustering divides a document collection into a handful of clusters—say, 10—that correspond loosely to subjects. An on-line collection of BYTE might yield clusters of articles about *Macintoshes*, *IBMs*, *laser printers*, and *programming*. In the case of an encyclopedia, clusters might

Don't Shoot It, Troubleshoot It.

LANDMARK... the widest selection of PC diagnostic software, firmware, and hardware in the world!



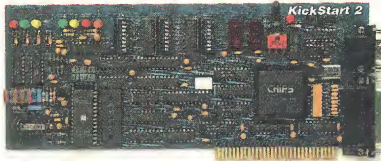
PC WON'T BOOT? KICKSTART IT!

Don't replace your motherboard, use **KickStart 2™**. When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 *measures power within 2.5% on all four voltages, shows Power-On Self-Test (POST) failure codes, and features on-board ROM-based diagnostics* allowing you to determine and remedy the problem quickly, easily, and inexpensively!

Built-in serial and parallel I/O *allows for testing remote via modem*, or simply logging results to a remote terminal, printer, or laptop. You can configure your own test routines and store them in KickStart 2's battery backed-up CMOS RAM for quick future use. On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk.

KickStart 2 is the ultimate **SECURITY CARD**, too. With two levels of password protection and pre-O/S activation, you can confidently prevent unauthorized use of your PC.

Includes serial and parallel loopback plugs and the landmark **JumpStart™** AT ROM BIOS for testing PCs that don't issue POST codes. KickStart 2 works independent of your operating system. You can use it in DOS or UNIX systems. **CALL for current pricing.**



"The number of tests KickStart 2 can perform is mind-boggling... IF THE KICKSTART 2 CAN'T FIND THE PROBLEM, IT PROBABLY EXISTS IN YOUR HEAD, not in the hardware."
Rich Santalesa, Computer Shopper

"KickStart 2 system diagnostics board helps users check out virtually every aspect of a PC's hardware system... THE BOARD IS A WORTHY INVESTMENT for computer maintenance."
David Claiborne, PC Week

PROFESSIONAL LEVEL PC TROUBLESHOOTING

Landmark **Service Diagnostics™** is ideal for professionals requiring the most exhaustive diagnostic test capabilities.

Service Diagnostics is not just a single product, but a complete LINE of products. It's comprised of software, hardware, and firmware so you can choose the best "tool" for the job.

When your PC won't boot, you'll need **ROM POST** firmware, a plug-in chip that virtually "jumpstarts" the system to determine what's wrong. And, when your printer isn't working, you won't know whether it's the LPT port, cable, or printer without hardware, like our loopback plugs (which together with our software completely test the COM ports).

To provide you a complete troubleshooting resource, Service Diagnostics is offered in single modules or in "kits." Components include; CPU-specific software (PC, XT, AT, 386/486, PS/2), ROM POSTS (PC, XT, AT) and floppy alignment disks (3.5" and 5.25").

All the Service Diagnostics software modules are available in self-booting versions for use with non-DOS operating systems like UNIX.

Service Diagnostics is powerful and flexible. Hundreds of tests can be performed on your motherboard, memory, video, COM ports, floppy and hard drives, printer, and more. **CALL for a customized quote on the kit that's right for you!**



THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With **AlignIt™** you can clean, diagnose, and align your floppy drives in minutes without a scope. Patented technology requires only a screwdriver to perform ANSI-accurate alignments (.3 mils).

AlignIt is ideal for corporate users with multiple PCs. The **GOLD STANDARD** feature allows you to align all your PCs to the same in-house standard, guaranteeing that all your floppies are perfectly interchangeable between PCs! Available in 3.5" or 5.25" for both high and low densities. **CALL for current pricing.**

PC DIAGNOSTICS MADE EASY

You don't need to be technical to use **PC Probe™**. With clear, intuitive, pull-down menus and 206 pages of on-line help, troubleshooting your PC is truly **MADE EASY!**

And, you don't have to be handy with a screwdriver to make PC Probe pay for itself. Just by providing a diagnostic report to your service and repair shop, you'll save money and receive quicker service.

PC Probe runs over 150 tests including; motherboard and CPU, memory, video card and display, keyboard, COM ports, floppy drive and controller, hard drive and controller, and more. Includes **VirusCure**, Landmark **Speed Test**, **AT SetUp** & loopback plugs. **CALL for current pricing!**



SLASH HARD DISK SET-UP TIME

If you install, upgrade, or maintain hard drives, then you need **DiskBase™**. It'll save you boat-loads of time and money by putting the exact hard disk information you need at your fingertips... whenever you need it.

DiskBase reveals 12 technical specs on over 2500 hard disk drive models and 8 technical specs on over 220 controllers. Once you've located the correct hard disk model, you can instantly bring up a listing of all compatible controllers. **CALL for current pricing!**

- Toll Free Tech Support
- 90 Day Money Back Guarantee
- Federal Express Shipping

CALL (800) 683-6696

FAX (813) 443-6603 • Int'l (813) 443-1331

LANDMARK
RESEARCH INTERNATIONAL CORPORATION
703 Grand Central Street • Clearwater, FL 34616

Copyright © 1992, PC Probe, AlignIt, KickStart, JumpStart, ROM POST, Service Diagnostics, DiskBase, and Speed Test are trademarks of Landmark Research International Corp. All Rights Reserved. Other names are trademarks of their associated owners.

Circle 198 on Inquiry Card (RESELLERS: 199).

ATTENTION 386 USERS
RUN SOFTWARE UP TO
3 TIMES FASTER

REAL CYRIX UNREAL PRICES.

Now get PC Week's "Top Rated"
FasMath™ coprocessor for 386SX
or 386DX PCs at a bargain price.

**FASMATH 83S87 MATH CHIP
FOR ALL 386SX PCs**

Now
\$ **79** *

Cyrix FasMath has won every
comparative PC publication review ever
held for math coprocessors.

Available at computer dealers
everywhere. Or call **1-800-FAS-MATH.**

*83S87 -33 for
386SX33PC; \$99

**83D87-40 for
386DX40 PC; \$129

Cyrix
Advancing the Standards

TOP RATED
**PC WEEK
LABS**

AUG. 27, 1990

1991
BYTE
AWARD
OF
DISTINCTION

COMPUTER
*Best
Performer*
SHOPPER

**FASMATH 83D87 MATH CHIP
FOR ALL 386DX PCs**

Now
\$ **99** **

Cyrix products are proudly made in the USA. Cyrix is a registered trade mark
and FasMath is a trademark of Cyrix Corporation.

THE INFORMATION THEATER

correspond to *economics, history, science, and art*. The computer designates a cluster with a list of keywords that distinguish it from other clusters and with titles from documents most typical of the cluster (i.e., those nearest the center of the cluster).

Like a table of contents, basic clustering gives you an overview of a document collection and how it breaks down. Even if you had never seen a particular database before, you would already have some idea of what's available to you.

Now you can select a few of these clusters, say, *IBMs and laser printers*, and tell the system to cluster the documents again. The IBM and laser-printer clusters are gathered into a single cluster, which is then scattered into new clusters. These new clusters might be *LaserJets, using IBMs with Apple printers*, and *programming for laser printers*.

Every time you iterate this process, the clustering becomes more fine-grained as progressively fewer documents are distributed among the same number of clusters (see the figure). You can iterate this scatter/gather process as often as you like, collecting clusters together and then scattering them apart again, backing up if you make a wrong turn. You could theoretically iterate all the way down to a single document.

The collection can be broken up in an almost infinite number of ways, to whatever granularity suits your purpose. At any time, you can jump into a similarity or snippet search to track down a particular document.

As with the snippet search, nothing here resembles a search language. Indeed, since you will rarely use the scatter/gather process to actually locate a single document, it is not really a search program at all. The NLTT group sees it as an information structuring and management tool (i.e., an aid to navigating large databases and understanding their contents).

Dynamic Data

Some databases do not sit still like an encyclopedia. Data accumulates off the *New York Times* news wire at about half a megabyte a day. Thus, while you're, say, in the Rockies for two weeks on vacation, your news database will accumulate another 7 MB of text.

Inevitably, some of this news will fall outside of existing categories. A new country will be formed, or someone will invent cold fusion. At this point, existing classification schemes fall down. But in the Information Theater, you can use the scatter/gather process to reorganize the database to accommodate this new category. In fact, you can reorganize the entire database around this new category. Halvorsen foresees a time when large text databases (e.g., encyclopedias) will be shipped with something like a scatter/gather capability to allow you to reconfigure or reindex it to suit your own needs.

Information-retrieval tasks run the gamut from simply browsing through a database to searching for a specific document. The Information Theater supports that range of uses. On the one end, it aids you in visualizing the structure of a space of documents. At the other end, it helps you to formulate queries and home in on documents.

All parts are fully interchangeable. You can jump from snippet search to similarity search and back again. If a search returns too many documents, you can use the scatter/gather process to organize them and extract the topics you want.

Now you can find those documents you've forgotten you own, or uncover the hidden structure in your hoard of forgotten PROFS notes, or set megabytes of data spinning in the air. It's all possible in the Information Theater. ■

Mark A. Clarkson is a freelance science writer living in Wichita, Kansas. You can reach him on BIX c/o "editors."



Now available for computers.

Files disappearing? Your Mac® not talking to your printer?
Your IBM® fighting with the rest of your network?

Don't worry. With CompuServe, you'll always have someone, somewhere to turn to for help in an emergency.

CompuServe gives you access to a world of support through hardware and software forums. Whether you're a novice or an expert, you'll always have problems, questions, concerns. No matter how basic — or complicated — just enter the appropriate forum. Your message will reach thousands of people with the expertise you're looking for. People who've solved the problems you're dealing with, and who will share the solutions with you. You'll even reach the authors of some of the most popular

software programs. And find information not available in any manual.

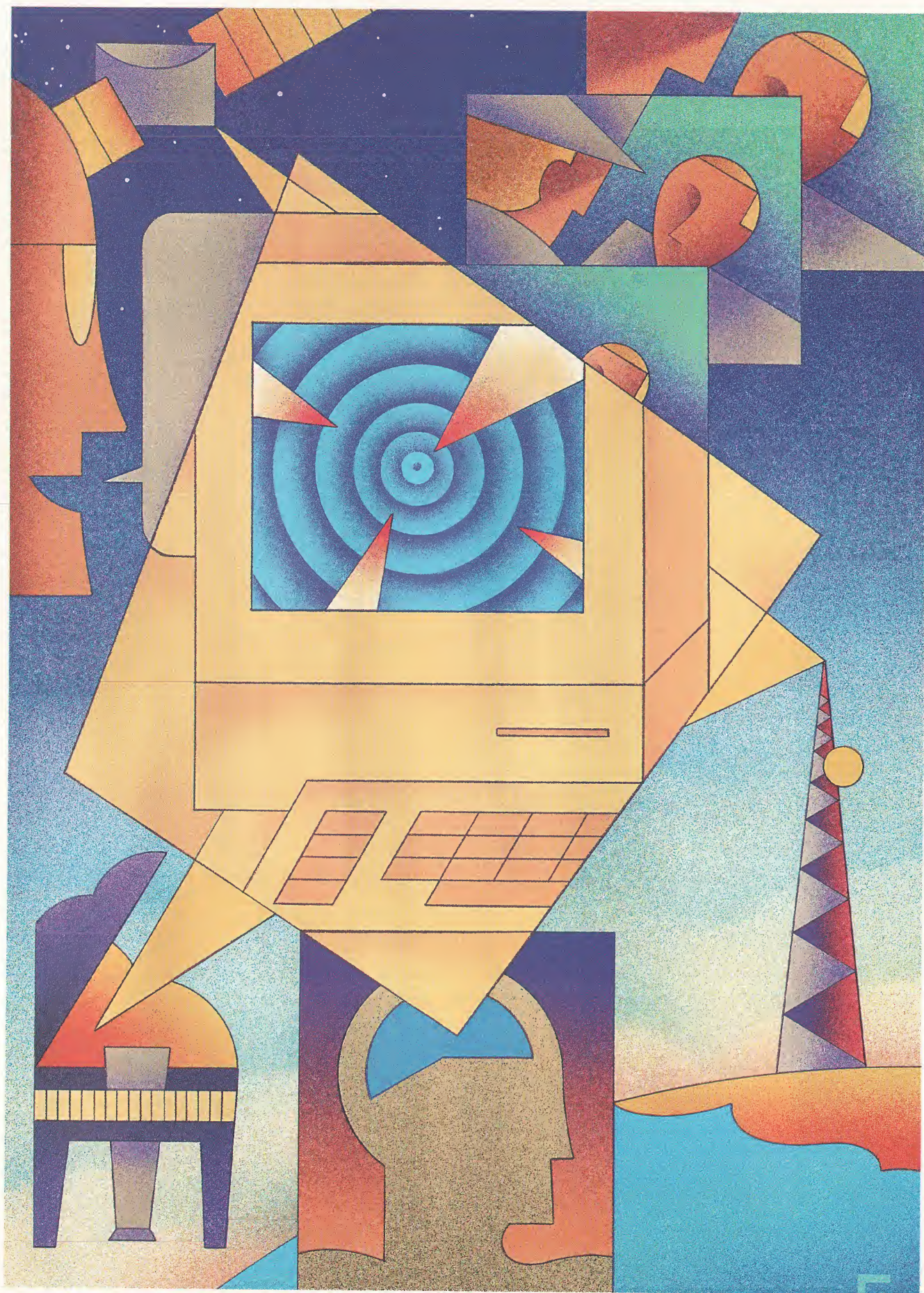
In addition to support, CompuServe also gives you more choices, by offering hundreds of in-depth online services.

CompuServe's hardware and software support forums. The only call you have to make to take the panic out of computer problems.

For more information or to order, see your computer dealer or call 1 800 848-8199. Outside the United States, call 1 614 457-0802.

CompuServe®

The information service you won't outgrow.



SIGNAL COMPUTING

Signal processing enhances a system's
audio, video, graphics, and communications capabilities

ERIC C. ANDERSON, STEPHEN SHEPARD, AND PHIL SOHN

Digital signal processing makes it possible for computers to interact with the world by enabling them to process real-world signals, usually in audio, video, or electromagnetic form. Signal processing can let you understand the information in a signal, transform it into a practicable form, or use it to synthesize information.

For example, a CAT scanner gathers information about the human body and uses sophisticated signal-processing algorithms to help medical professionals diagnose internal disorders. An audio-compression algorithm allows more audio to fit on a storage device. And signal processing is used extensively to create signals: You can now control an orchestra of instruments using a modern music synthesizer.

Signal processing is getting more attention in the personal computer arena because many host processors are now fast enough to do simple signal processing. More important, fixed-function and programmable DSP (digital signal processor) chips are coming down in price, making it feasible to build them into motherboards. Signal processing makes practical specific applications (see the text box "Digitally Speaking" on page 160). Some people call DSPs the math coprocessors of the 1990s—ICs that provide a significant performance boost for specific applications or operations, including audio, video, graphics, and communications. If the computer you are using doesn't have a DSP in it, your next one most likely will.

What Is a Signal?

People use the term *signal* in many different ways. You talk about radio and TV signals, traffic signals, and automobile directional signals. In signal processing, *signal* refers to physical properties that change with time, such as electromagnetic waves. These signals are converted by a transducer into another form (usually electrical) that can more easily be manipulated or processed. Examples of such signals include audio, radio, and TV signals. Other types of signals include multidimensional correlated data (e.g., photographic images and sonograms).

An example of a transducer is a microphone, which converts

sound-pressure variations into a voltage that varies proportionally with the sound pressure. Another common transducer is a speaker, which does the reverse of a microphone, converting an electrical voltage to an air-pressure signal.

The electrical signal produced or used by a transducer is referred to as an *analog* signal. The only limits on the accuracy of a re-created analog signal are the physical properties of the transducer and interference, or noise, in the system.

Signal Parameters

The two basic parameters for signals are the *frequency* and the *amplitude*. The frequency of a signal refers to the number of times that the signal varies per second. Frequency is measured in hertz (i.e., cycles per second). For example, human speech is in the frequency range of 300 to 3000 Hz. AM radio is in the 550- to 1650-kHz range. And FM radio is in the 88- to 108-MHz range.

Frequency (f) is an inverse function of the time (T) between fundamental peaks or valleys in a signal: $f = 1/T$. The time (T) is called the *period*.

Amplitude is a measure of the strength of a signal. It's measured in various units depending on the application. For audio signals, the measurement is in decibels, which is a logarithmic scale based on human-hearing sensitivities. For audio,

Signal Computing

BY ERIC C. ANDERSON,
STEPHEN SHEPARD, AND PHIL SOHN
154

Signals on the Desktop

BY JOHN BRYAN
167

Inside Signal Computing

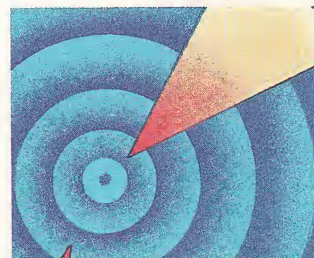
BY PETER WAYNER
177

A Platform for Signal Computing

BY TIM COUNIHAN
185

Resource Guide: DSP-BASED PRODUCTS

190



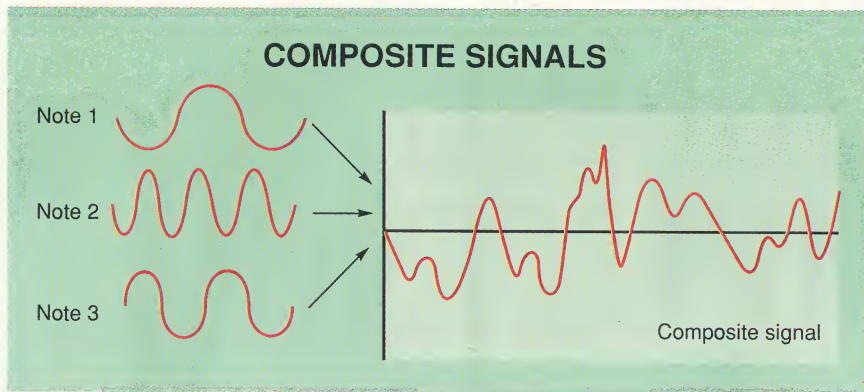


Figure 1: The three notes that make up a chord each produce their own simple signal, harmonics aside. The composite signal results from the combination of the simple signals. DSP systems use techniques based on Fourier's theorem to deal with the construction and decomposition of composite signals.

amplitude is volume; for video, it's image contrast.

Signal Characteristics

A signal characteristic can change depending on the frequency and amplitude. For example, at very low frequencies, air pressure is barometric pressure. This signal has a period in the range of hours or days. The same signal at shorter periods, however, is called *subsonic* and ranges from only a few cycles per second to approximately 20 Hz. These signals cannot be heard, but if they are strong enough, they can be felt.

The audio range is higher than the barometric or subsonic ranges in frequency (from 20 Hz to around 20 kHz), depending on your age and the condition of your ears. Above 20 kHz is the ultrasonic range. This is the range of dog whistles and some remote control devices. Ultrasonics are directional in nature and can follow fairly tight beams.

Note the difference in the function of a signal depending on its frequency. All the signals are from the same physical property: air pressure. However, the function of the signal changes drastically with the frequency range.

Composite Signals

A signal can consist of many separate components that propagate at different frequencies and amplitudes. Such a signal is called a *composite* signal. An example of this would be a recording of a chord from a pipe organ: Each note produces a single tone, but when several notes are combined, they form a complex waveform (see figure 1). Another example is the radio spectrum, which is composed of hundreds of signals from radio and TV stations, aircraft, and so forth.

Another important signal parameter is *bandwidth*, which describes the range in frequencies of a complex signal. For instance, the bandwidth of a high-fidelity audio signal is 20 kHz; the bandwidth of a video signal is 6 MHz.

While a complex signal may be difficult to use directly, it's possible to select portions of the signal by using filters. A filter allows the passage of a signal within a range of frequencies and prohibits the passage of signals with frequencies outside of that range. A radio tuned to a station contains a sharp filter that selects only the signal from that radio station and eliminates all others. At higher frequencies (e.g., visible light), you use filters to select or to filter out colors (i.e., frequency ranges). Tone controls on audio equipment are another common type of filter.

Underlying an understanding of composite signals is the Fourier theorem, which states that any periodic signal can be described as the sum of single-frequency sine waves of various amplitudes. This makes it possible to extract the individual component sine waves that make up a composite signal and to synthesize any composite signal with a set of sine-wave generators. The former technique is used to extract information from a signal; the

latter is used for music, speech, and waveform synthesis.

Digital and Analog Signals

Historically, most electronic signal processing has been done on analog signals with analog components (e.g., transistors, transformers, and capacitors). But it's difficult and costly to create analog-signal-processing components with precise values that do not change significantly with time and environmental fluctuations. Digital electronics let you compute the effect of components on a signal using mathematical operations. Digital signal processing is a precise method unaffected by time and environmental changes.

As digital processing speeds have increased, people have begun to use DSPs to do processing that is not practical in the analog domain. This is due to a number of factors. First, unlike normal electrical components, digital components operate precisely as expected, with no losses, distortion, or other physical effects to the accuracy of the numeric representation used. Second, mathematical operations representing component functions that are not physically realizable are easily computed. And third, because digital components are programmable, you can change the signal-processing function by reprogramming it rather than by resorting to a soldering gun.

The result of digital technology is new or better signal-processing functions. For example, selective filters are possible in the digital domain that are impossible at any cost in analog signal processing.

Discrete-Time and Discrete-Amplitude Signals

Most of the signals discussed thus far are continuous-time signals, which can have any value from an infinite number of values within a specific range. This value can be measured at any time. Signals that have values only at specific times are called *discrete-time* signals. An example of one is the number of people in a theater at a specific time. This will be an integer from 0 (a very bad movie) to the maximum seating limit (a hit movie). The discrete period is one day. You can enter a set of values from this signal into a digital computer for processing in many useful ways.

A discrete-amplitude signal has one of a set of values at any given time. A simple example of this is a traffic light, which can have only one of three values—red, yellow, or green—at one time.

Sampling and Quantization

Before digital computers can process signals, the analog signal must be converted into a digital signal. A digital signal has

Signal types

- audio
(e.g., voice, sound, and music)
- video
- radio
- microwave
- images

Who's Really The Fastest?

DRIVES COMPARED FOR 50Mb TRANSFER*(in seconds)

Alphatronix INSPIRE®II	77.83
Quantum®105s hard drive	91.95
Pinnacle PMO-650™ "optical hard drive"	102.82
Sony® SMO-E501 optical drive	155.50

You Make The Call: 1-800-849-5807.

As you can see, the INSPIRE II optical drive is far faster than the much-ballyhooed "optical hard drive," is comparable to your typical hard drive and is many times faster than previous optical drives. And the INSPIRE II is made with the superior quality and reliability that has made Alphatronix the acknowledged leader in high-end optical systems.

Call The Source Of Optical.

Our reputation for quality and innovation goes back to 1988, when we shipped the world's first rewritable optical system. In 1989 we were presented the national Distinguished Inventors award. In the years since, we've received even more national awards for quality and excellence. Alphatronix has become the hands-down choice of some of the world's toughest customers, including NASA and the Lawrence Livermore National Laboratories.



Gain Significant Advantages.

Now that same level of quality, performance and support is available for your PC, PC-compatible, Mac, DEC or UNIX workstation at a lower cost per megabyte. You can have the speed of a hard drive with the added advantages of optical: greater reliability and more megabytes on a removable, portable media. Aside from having vastly more storage, your system will never know the difference. INSPIRE II lets you simply "plug and play".



The world's first
optical drive is now
the world's fastest.

Why Waste Time?

So what are you waiting for? You know who's got the fastest optical drive, and you know who's got the best. Stop waiting and call us today at 1-800-849-5807. We'll send you free comparative test results, specs and everything you need to order the INSPIRE II. Only you can make the call.

SEEK TIME (in milliseconds)	
INSPIRE II 23	
Pinnacle PMO-650	39
Actual times recorded in identical tests for average time to seek to any random sector on disk.	



ALPHATRONIX® *The Source Of An Industry.*

P.O. Box 13687, Research Triangle Park, NC 27709-3687 Phone (919) 544-0001; Fax (919) 544-4079

*Read 50 Mb data stored in sequential sectors at 32 Kb/read request. Complete details of benchmark environment and procedures available upon request.
Alphatronix, the Alphatronix logo, and Inspire are U.S. registered trademarks of Alphatronix, Inc. Other trademarks and product names are the property of their respective owners.

For Macintosh information circle 80; for IBM/Compatible information circle 81; for SUN information circle 82 on inquiry card.

both discrete time and discrete amplitude. The first step of the conversion is accomplished by a process called *sampling*, which converts a continuous signal to a discrete-time signal.

A motion picture is a good example of sampling. The seemingly continuous motion of a movie is made up of a series of discrete-time images presented at a rate of 24 frames per second. The original action is sampled at a rate of 24 samples per second by the movie camera. The human eye reconstructs the original motion from the series of still images.

The second step in converting an analog signal to a digital signal is called *quantization*, which converts a continuous-amplitude value into a discrete amplitude value. The most common type of quantization is called *uniform quantization*.

Uniform quantization is simply a matter of putting the analog value of each sample into one of a set of possible bins. For example, if you are converting a voltage from 0 to 1 volts into an 8-bit number (values of from 0 to 255), each digital bin has a voltage range of $1/256$ V, or approximately 0.0039 V. Bin 0 is used for voltage from 0 to 0.0039; bin 1 is used for voltage from 0.0040 to 0.0078; and so forth, as shown in figure 2. Clearly, quantizing the signal loses information and introduces quantization noise into the signal. The greater the number of bins, however, the less noise is introduced. This is why a 16-bit audio system sounds so much better than an 8-bit system.

The process of sampling and quantization is called *A/D conversion*. The converter normally operates at a fixed sampling rate, measuring and quantizing the value of the signal once per sample period. These values are passed on to the digital system for storage and processing.

For multidimensional signals (e.g., a photographic image), conversion into the digital domain is accomplished by using a scanning process. This process generates a two-dimensional array of digital pixel values. Video uses a similar process called a *raster scan*.

Time vs. Frequency

You can represent and view signals in various ways. The two most popular representations are the time and frequency domains. The time domain shows the signal amplitude on the y axis and time on the x axis. Figures 1 and 2 are time-domain representations of signals. Time-domain representations show the signal within a particular time slice. You can see a continuous display of time-domain representation with an oscilloscope.

Often, you need to analyze the frequen-

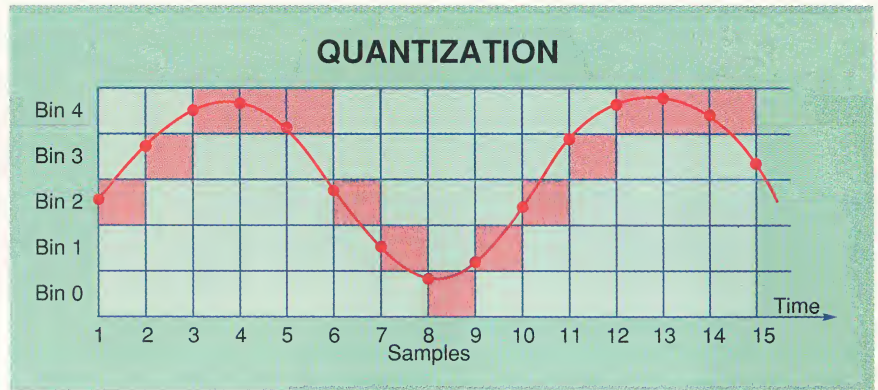


Figure 2: Note the noise introduced by quantization. Sample 5 is placed in bin 4, and sample 6 goes to bin 2. The signal clearly passes in the range of bin 3, between these two samples, but the sample rate is too coarse to detect this.

cy content of a signal. For this, you must have a frequency-domain representation of the signal. This type of representation has amplitude on the y axis and frequency on the x axis (see figure 3). This representation shows the frequency components of the signal for a particular time slice instead of the time-domain representation. A continuous version of this type of display is often found on more expensive high-fidelity equipment. The equivalent to an oscilloscope for frequency domain is the spectrum analyzer.

The process of going from the time domain to the frequency domain is called a *Fourier transform*, a mathematical transformation based on Fourier's theorem. A naturally occurring example of such a transform is the prism, which takes in a composite signal—natural light—and breaks it up into the separate frequencies (i.e., colors) that are contained in the light. In effect, the prism is a signal processor.

In the analog domain, the amplitude of a signal at any given frequency is gener-

ated by a series of sharp filters tuned to progressively higher frequency bands. In the digital domain, the frequency content of a signal is calculated by using the DFT (discrete Fourier transform). An effective DFT algorithm is called the *FFT* (fast Fourier transform). This algorithm eliminates unnecessary or duplicate calculations from the DFT and produces the same number of frequency spectrum values as sample values.

The Nyquist Theorem and Aliasing

When designing a digital signal-processing system, an important consideration is selecting the sampling rate. If the input signal is band-limited (i.e., the frequencies in the input signal are below a frequency f), the input signal can be reconstructed from the sampled signal provided the input signal is sampled at least $2f$ times per second. Frequency f is called the *Nyquist frequency*. Thus, a 20-kHz bandwidth audio signal must be sampled at at least 40 kHz for it to be properly reconstructed.

continued

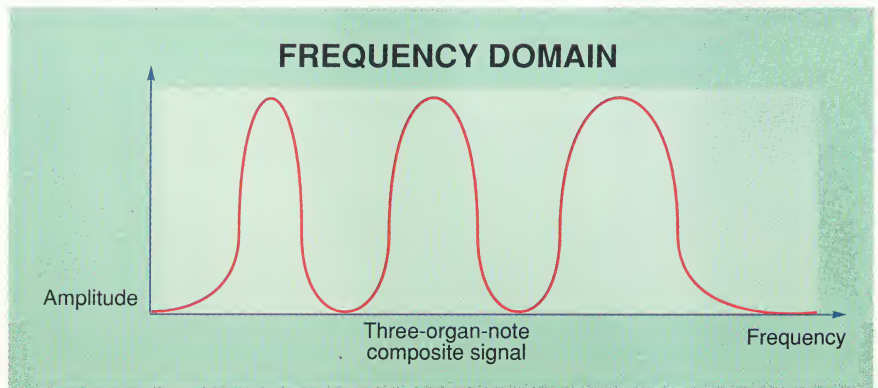
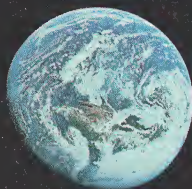


Figure 3: Applying Fourier's theorem in the form of a Fourier transform allows you to move from the time domain to the frequency domain, where a composite signal is represented by the frequencies of its constituent simple signals.

*Look on the bright side.
We know our data's
going to survive.*



Verbatim® tapes, optical and floppy disks. Your best defense against data loss.

Circle 214 on Inquiry Card.



Digitally Speaking

GEORGES ZANELATO AND BART VERHAEGHE

The introduction of DSPs (digital signal processors) has contributed immeasurably to speech-based applications. DSP power is used in many areas, including transmission-noise reduction; signal amplification; speech synthesis for text-to-speech conversions; speech recognition; and voice-message coding.

In text-to-speech conversions, the DSP processes ASCII text, generates a phonetic transcription, and produces the synthetic speech. In speech recognition, the DSP system, in conjunction with an A/D converter, acquires the speech, compares it to stored templates, and indicates what word was uttered. The applications determine how to process the recognition results.

Voice Coding

Coding has gained wide use in voice-mail storage. The idea is to let you record messages to a hard disk for future retrieval. Such voice messages, or even voice-annotated documents, can also be sent over networks. On request, you can retrieve, decode, and play back these messages.

Coding rates provide great savings in storage space, an important factor in applications such as dictation, voice annotation, PC-based automatic answering machines, voice mail, and digital telephone-answering machines. An un-

coded voice file typically requires about 0.5 MB of memory for 1 minute of recorded speech. Using a DSP on the motherboard or on an add-in board can reduce the memory required by as much as 85 percent. And coding algorithms are a must when documents containing voice annotations are sent over a network or through a modem.

The SBCELP Algorithm

A number of different types of voice-coding algorithms are available. Lernout & Hauspie Speech Products of Belgium introduced a coding technique called SBCELP, which is based on a CELP (code-excited linear prediction). It performs coding and decoding of speech signals at fixed bit rates in the range of 2000 to 10,000 bps. After coding, the memory requirement for 1 minute of speech is reduced to a range of 15 to 75 KB. This is as much as a 30-fold savings in storage space over unencoded speech.

The SBCELP algorithm consists of three major parts, each one corresponding to a section of the human speech production system. In the first part, the STP (short-term prediction) analysis extracts the envelope of the input signal. This is performed via a tenth-order LPC (linear prediction coding) filter. The envelope corresponds to the first part of the vocal tract, from the

lips to the vocal cords.

You can view the LPC filter as a succession of 10 acoustic tubes that represent the vocal tract. As the vocal tract is warped along the speech signal, the corresponding tubes are modified in length and diameter, furnishing new values for the LPC coefficients. (Because those coefficients are sensitive to quantization errors, the algorithm uses the LSP [linear-spectrum-pairs] coefficients, which are less sensitive to these types of errors.)

The second part of speech—the vibration of the vocal chords—is characterized by frequency, or pitch. The LTP (long-term prediction) analysis furnishes a value related to the pitch of the input signal.

The third part of a speech signal represents the excitation of the signal (i.e., the air coming out of the lungs). Determining the spectral shape of the excitation is important if you want to keep the natural quality of the human voice and avoid the metallic effect of digital-speech playback. To solve this problem, the algorithm determines the best possible excitation candidate for the excitation signal from among the reference signals. These references can be prefixed and stored in a dictionary or codebook, or they can evolve dynamically with the signal, as is done in the LHS SBCELP algorithm.

If you sample a signal below the Nyquist rate (sub-Nyquist sampling), you get aliasing: The sample points do not contain enough information to reconstruct the original signal. Aliasing causes frequencies in the input signal above the Nyquist frequency to generate undesirable frequencies in the digital signal. These frequencies form a mirror image around the Nyquist frequency. For example, if there is a 22-kHz signal in the audio before it is sampled at 40 kHz, the digital signal will contain an 18-kHz signal but not the 22-kHz signal. To ensure that aliasing does not occur, you must filter the signal to remove any components above the Nyquist frequency before it's converted to the dig-

ital domain. This type of filter is called a *low-pass filter* because it passes all signals below a specified frequency.

You can see aliasing at work in a movie whenever the 24-frame-per-second sampling rate is too low to capture rapid motion. A well-known result is the effect of wagon wheels appearing to turn backward. In effect, there is insufficient information for the human eye to properly reconstruct the original signal.

Signal Reconstruction

Once a signal is digitized and processed, you often want to return it to the analog world so that it can be reconverted to its original form. This can take place in real

time, or it can be delayed. Playing a CD is an example of a delayed reconstruction of a digital signal.

A raw digital signal that has been passed through a D/A converter would normally be unsuitable for direct use, because the converted signal is a staircase function following the path of the original signal and contains many additional signals above the Nyquist frequency (see figure 4). According to the Nyquist theorem, you can use a *perfect* filter to reconstruct the original signal from the staircase generated by the D/A converter. A perfect filter passes all frequencies below the Nyquist frequency and blocks any signal above the Nyquist frequency. Such a filter has a pass-

To carry out this three-part coding on a DSP, you must first sample the analog speech signal at a frequency that varies according to the application. The speech quality offered by the telephone network is usually satisfactory for voice mail, answering machines, and voice annotations. In these cases, the sampling frequency chosen is usually 8000 Hz. Each sample can be represented by 8, 12, or 16 bits, which fixes the amount of memory needed to store a second of speech signal (64,000 bits, or 8 KB, in the first case). The digitized input signal is divided into successive frames of 15- to 40-millisecond duration, depending on the chosen final bit rate (from 2000 to 10,000 bps). The system performs an STP analysis. The corresponding 10 LSP coefficients are then quantified into a 24- or 32-bit number, depending, once again, on the bit rate. These bits are the code for the STP analysis.

At this point, each frame is divided into two, three, or four subframes for the computation of the LTP analysis and the dictionary search. The number of subframes is determined by the final bit rate. This allows you to deal with short frames (of about 5 ms) to keep the values for the pitch and the dictionary as precise as possible all along the speech signal. This is necessary because of the continuously changing shape of the excitation and of the vocal cord's

vibration frequency.

Obviously, there is a trade-off between the speech quality and the number of bits used to code the LTP analysis and the dictionary candidates. The number of bits allocated to each feature, linked to the size of the frame and the number of subframes, determines the bit rate. The existing values are 2400, 4000, 4800, 7200, and 9600 bps. However, any bit rate between 2000 and 10,000 bps can be adopted after some fine-tuning of the algorithms. Enhanced perceptual- and dynamic-filtering techniques enable the algorithm to keep good speech quality, even for bit rates as low as 4800 bps.

Coded speech is stored in 8-bit chunks. The decoding process enables the reproduction of coded speech in real time. The coding algorithm needs about 12 MIPS of computational power; decoding requires 1.5 MIPS. Numerous low-cost DSPs are available that can perform these tasks. Such processors will enable a new generation of speech applications.

Georges Zanellato is the R&D manager of speech and music coding at Lernout & Hauspie Speech Products. Bart Verhaeghe is the manager of the company's U.S. marketing operations. You can contact them on BIX c/o "editors."

band from 0 to the Nyquist frequency, a zero-width transition band, and a stop band from the Nyquist frequency to infinity. A frequency-domain plot of the perfect filter is shown in figure 5.

The process of filtering the output signal is called *convolution*. You multiply the time-domain representation of the characteristics of the frequency-domain filter by the current sample, n previous samples, and n future samples for each output sample. These multiplications are called *filter taps*. A filter that requires 10 multiplication operations is referred to as a 10-tap filter.

Because you must use future samples to calculate the reconstructed signal, the filter processor must wait until these sam-

ples are available. This causes a time delay in the filter of n samples.

The time-domain representation of the perfect lowpass filter is the synchronization function $(\sin x)/x$. Unfortunately, this function extends to infinity in both directions, so the convolution computation must include an infinite number of multiplication operations and an infinite delay. So, you need a way of reducing the value of n .

In the real world, you reduce n with a filter that has a transition band of significant width. This is done by windowing the synchronization function to limit its nonzero value range and, therefore, the number of calculations per sample to an acceptable level. This technique also reduces the pass-

band to below an optimal level. However, this can be compensated for by using a higher sample rate than the minimum Nyquist rate. This is why the CD sample rate is 44.1 kHz. The 22.05-kHz Nyquist rate is beyond the human hearing range, but the extra bandwidth allows a low-cost sampling and reconstruction filter to begin rolling off into the transition band at around 18 to 20 kHz, as shown in figure 6.

Digital Filtering

There are many forms of filters in signal processing; they are classified according to the function they perform. For example, lowpass filters pass low frequencies while attenuating the higher frequencies. High-pass filters pass high frequencies and attenuate lower frequencies. Bandpass filters pass frequencies in a range, or band, while attenuating frequencies outside the band.

Filters are also classified according to the way they are implemented. One common implementation uses both the input and output samples to calculate the filtered output signal. Because you feed back the past output samples of the filter to compute the current output sample, you continuously recycle energy within the filter. This means that the response of the filter to an impulse (or spike) is infinite in length. This type of filter is called an *IIR* (infinite impulse response) filter.

IIR filters are often used because of their ability to create sharper transitions with little computation. However, one of the desirable attributes of a filter, called *linear phase*, is missing in an IIR filter. Linear phase refers to the characteristic where all frequency components of the original signal are delayed by the same number of samples before they arrive at the output.

Another common filter implementation called an *FIR* (finite impulse response) filter uses only its input samples to calculate the filtered output signal. In this case, an impulse applied to the filter will die out after n samples, where n is the number of taps in the filter.

The advantage of FIR filters is that they are linear phase. Unfortunately, more computation is required to achieve the desired sharp transitions with this filter design.

Digital Storage and Real-Time Processing

Digital signals can be stored on hard disks for editing and playback. Although this is an obvious use of these signals, only recently have desktop computers had enough storage and processing speed to make this possible.

Processing-speed requirements can be divided into two major categories: real-time

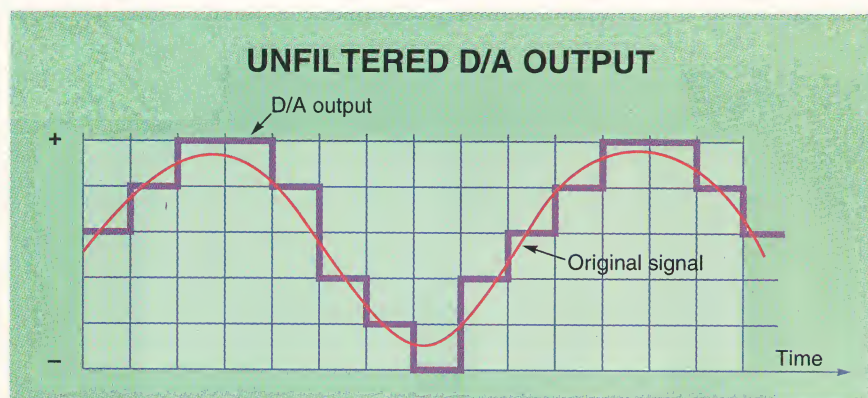


Figure 4: Digital signals converted directly to analog show a staircase effect and in some cases produce signals above the Nyquist frequency.

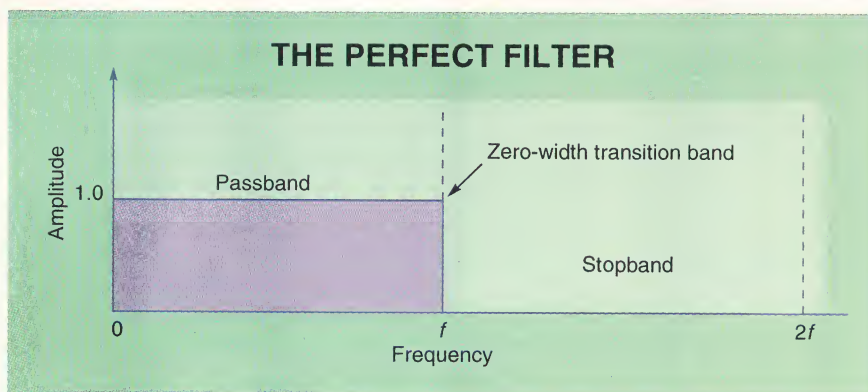


Figure 5: Viewed from the frequency domain, a perfect filter stops all frequencies above f , the Nyquist frequency.

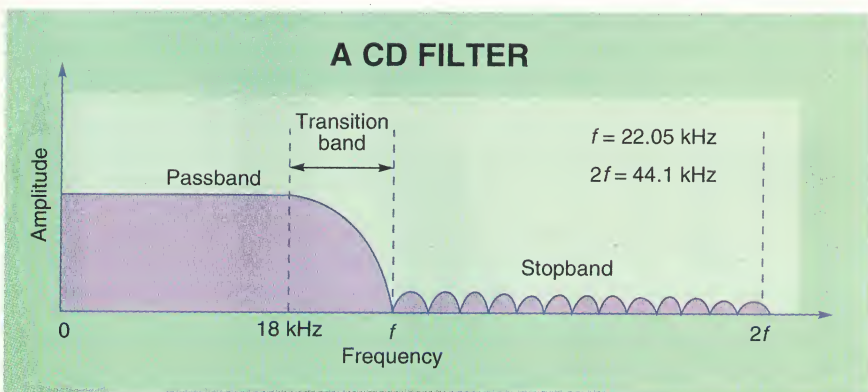


Figure 6: To keep processing needs reasonable, a real filter for CD playback uses a windowed synchronization function and depends on a sampling rate that is more than two times the Nyquist frequency.

processing and non-real-time processing (which is also called *background*, or *time-share*, processing). Real-time processing occurs when the process can accept or produce sampled data at the same rate as the conversion hardware. Furthermore, real-time processing implies a reasonable guar-

antee that the process will not be interrupted or late, so a continuous flow of data can be supported between the process and the conversion hardware.

Non-real-time processing is used to process data over a period of many hours or days. The results are stored in memory or

on-disk and are analyzed or played back in real time. This type of processing is useful when insufficient processing is available to handle the desired function in real time.

Consider the processing required to handle stereo CD audio in real time. There are 44,100 samples per second per channel that must be processed. If the desired processing is a filter with 40 taps, each of which requires one multiplication operation and one addition operation (multiply-accumulate, or MAC), 7.056 million operations per second are required (two channels \times 44,100 samples \times 40 taps \times two operations). This processing load can be handled by most modern-day DSP chips. However, a standard RISC or CISC processor would require many times this number of instructions per second to do this type of calculation, because separate instructions are required to access, load, and store the data. To process a similar video filter in real time, over a billion calculations per second are required. This is the reason most video signal processing is done with custom chips.

In addition to requiring a great deal of processing power, these digital signals take lots of space. For example, an hour of CD-quality music takes over 600 MB of storage, and a minute of video takes over 500 MB.

Data Compression

One of the most popular signal-processing functions is data compression. Signals can be compressed, or coded, to reduce their large storage requirements. There are two basic types of compression: *lossless* and *lossy*. These terms refer to the effect the compression algorithm has on the information in the original signal.

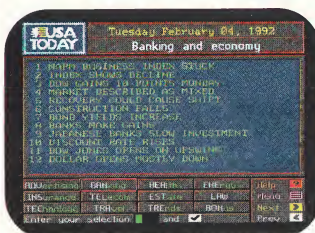
Lossless compression is used when a reconstructed signal must be the same as the original signal. A common example of lossless compression is disk file compression. Lossless-compression algorithms can usually compress digital data up to one-half to one-quarter of its original size. Some common lossless-compression algorithms are Huffman and Lempel-Ziv.

Lossy compression algorithms are used when the reconstructed signal does not have to be identical to the original signal. This is the case with audio, video, and image compression. These data types often have more information than can be perceived by the human receiver. Thus, the compression algorithm can afford to lose information.

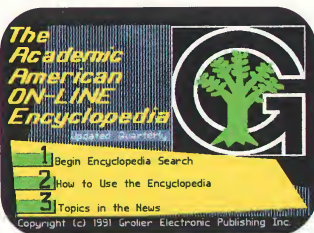
Lossy compression can frequently compress digital data to as much as one-tenth to one-hundredth or more of its original size, depending on how much computation can be expended and the desired quality of the reconstructed signal. Lossy algorithms

Satisfy your curiosity for only \$5⁹⁵*

New
On-Line
Service



Stay on top of current events, business trends, sports, the weather, and the world of entertainment with USA TODAY®.



Your entire family will benefit from the complete, regularly updated Academic American Encyclopedia from Grolier's®.



Keep up-to-date with stock market quotations on Financial Market Quotations. Also check commodities, currencies, options, and bonds.



American Airline's EAASY SABRE® reservation system lets you shop for the best fares and make your flight, hotel and car reservations online. With EAASY SABRE you can plan every business trip and family vacation with ease and efficiency.

No matter what you're interested in, satisfy your curiosity about the world and the people in it with the National Videotex Network (NVN). Easy to use, with high resolution graphics, and an even better-looking price. And NVN features AT&T's state of the art digital network.

For just \$5.95 a month, NVN gives you unlimited access 24 hours a day to over 80 basic services including news, sports, financial information, games, entertainment, education, and so much more. You get 60 free electronic mail messages a month, with additional messages costing only 20¢ each.

You'll experience "real-time" conversation on our exclusive, premium service, Let's Chat USA,® where you can meet and talk with hundreds of people throughout the country.

For only \$5.95 a month, there's no reason not to satisfy your curiosity. To join NVN simply set your 1200 or 2400 baud modem and dial 800-336-9092. Upon connection enter BM920L then press <Return>. Call now to order and receive your software absolutely free.

800-336-9096



* Basic Package price of \$5.95 a month does not include premium services. Price and service content subject to change. Some features subject to surcharge. Connect time for premium services will be billed at \$9.00/hour 8am-6pm, \$6.00/hour 6pm-8am weekdays. \$6.00/hour all day Saturday and Sunday, Central time zone. National Videotex is a pending mark of National Videotex Network Corp. All others are for identification purposes only and belong to their respective companies or organizations.



Video Frame Grabber

Now with animation capture and sound support!

ComputerEyes/RT - affordable, accurate, 24-bit video frame grabber for IBM PC computers. Includes everything you need to capture high-resolution 8-, 16-, or 24-bit color (or 8-bit gray scale) images from any standard composite or S-video source in real time.

Supports VGA, SuperVGA, HiColor, and true-color display boards. Saves image files in all common formats - TIFF, Targa TGA, PCX, GIF, BMP, and more. Hundreds of applications!

ComputerEyes/RT includes new CineMaker animation capture software for capture of motion video clips in standard animation formats. Also supports popular audio boards for simultaneous capture of sound with animations! Windows and developers software packages also available.

ComputerEyes/RT - \$599.95.
New Monochrome /RT version now available - \$399.95!

Also available - new low-cost TelevEyes VGA-to-TV converter - under \$300!

See your dealer or call (800) 346-0090 for more information and free demo.



Digital Vision, Inc.
270 Bridge Street
Dedham, MA 02026
(617) 329-5400

SIGNAL COMPUTING

include ADPCM (adaptive differential pulse code modulation), CD-XA (Compact Disk Extended Architecture), and subband for audio; JPEG (Joint Photographic Experts Group) for images; and MPEG (Moving Pictures Experts Group) for both audio and video data.

Nonuniform quantization is also used for compressing signals. One of the most widespread techniques is called *vector quantization*. Instead of the signal being stored one sample at a time, a token representing an entire set of samples (called a vector) is stored. For example, if the sequence "one, two, three, four, five" occurs often in a signal, a token can be used to represent the sequence. This technique derives the correct set of tokens at the compression end and requires an enormous number of calculations. Decompression is fast, however, and requires only a simple table lookup. This allows the use of low-cost playback equipment to decompress the signal.

Sample-Rate Converters

It is often useful to convert a signal from one sample rate to another. This is generally required when passing a signal from one system to another. For instance, a signal recorded at 48 kHz on a professional digital tape deck may have to be converted to 44.1 kHz for storage on a CD. Another example of sample-rate conversion is when a signal is passed between an audio system and a telephone system. Each of these systems has a different sample rate, selected for optimum utility for a given function. Digital telephone systems typically use an 8-kHz sample rate, and digital audio systems usually use 44.1 kHz or 48 kHz.

Sample-rate converters are of two types: up converters and down converters. The up converter generates more output samples than input samples; the down converter does exactly the opposite. In either case, the computational process takes the basic form of a digital filter that removes aliases and unwanted out-of-band artifacts.

Adaptive Filtering

There are numerous cases where simple filtering is not effective or where the cost of the filter is too high for an application. In these cases, adaptive filtering is often used. An adaptive filter adjusts its parameters based on the content of the signal. In fact, adaptive processes can select from a set of possible filters, depending on the signal.

An interesting example of this is the CD-XA compression algorithm. In this technique, audio is broken up into blocks

of 28 samples. Depending on the content of each block of audio, one of four different filters is selected that will best match the original signal during decompression. This takes substantial processing during the compression stage—each block must be compressed four different ways and then decompressed and compared to the original signal. The best match is selected, and the coded form becomes part of the compressed data stream. The filter selection is included in the data stream to allow the

DSPs will change the way you interact with your computer.

decoder to use the correct filter for that block.

The advantages of this approach are that the highest computation is required during encoding and that simple filters can be used during decoding. This is desirable because compression usually happens once at the production facility and playback can occur hundreds of times by many people in different locations. Similar operations can be performed with adaptive filters in noise-canceling and noise-reduction applications.

Future Signals

As digital signal processing becomes widespread and processing power increases, more focus will be placed on functions for personal computers and digital assistants that until recently were only dreams. Digital signal processing makes it possible for your computer to use multimedia information in real time.

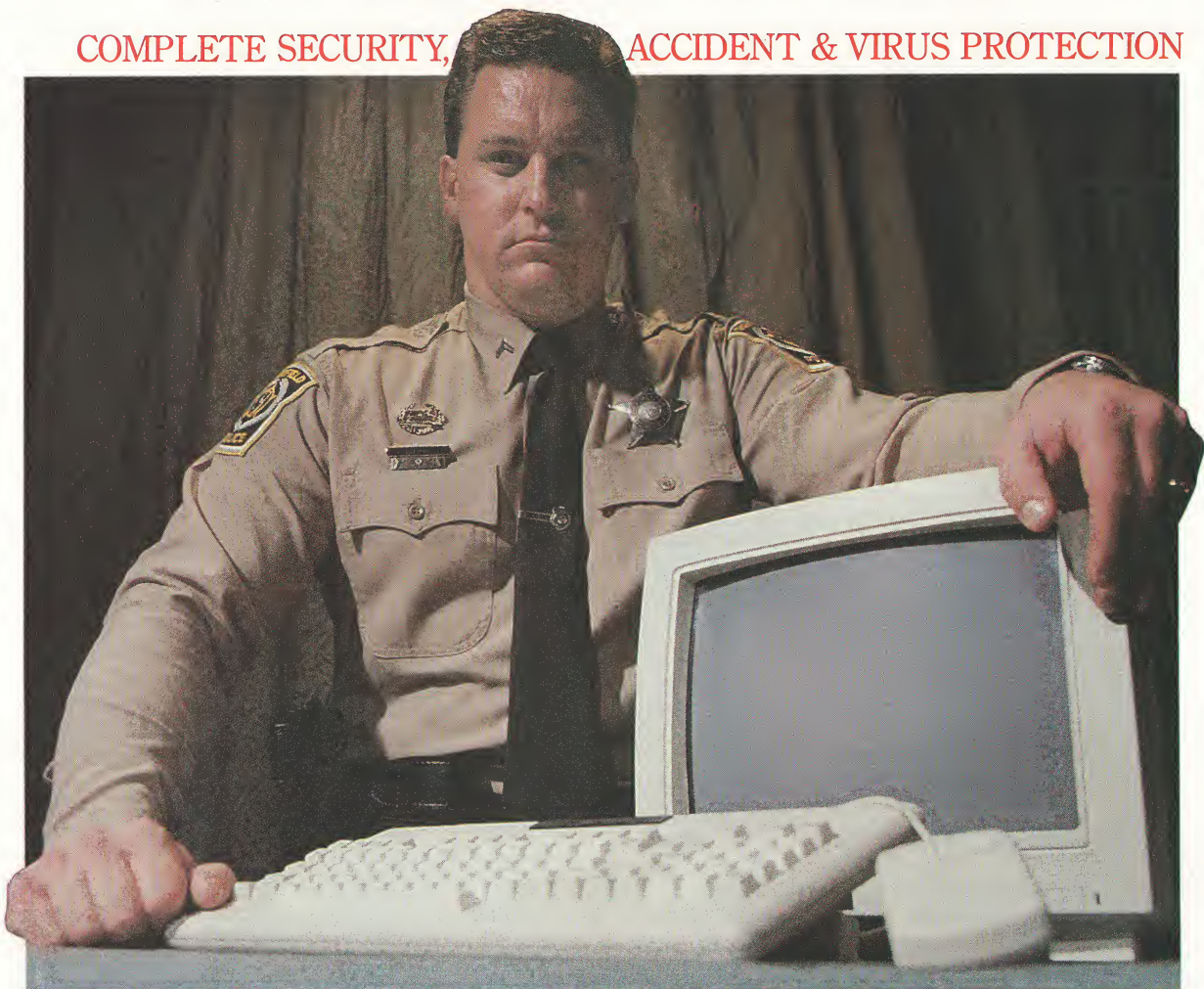
You can look forward to a rapid proliferation of amazing new capabilities over the coming years based on the marriage of DSPs and standard CPUs. From speech recognition to real-time digital video, DSPs will change the way you interact with your computer. ■

Eric C. Anderson is manager of the Sound & Signal Processing Group within the Advanced Technology Group of Apple Computer (Cupertino, CA). Stephen Shepard and Phil Sohn are members of the group. You can contact them on BIX c/o "editors" or on AppleLink as "anderson13."

Close the Windows. Lock the DOS.

COMPLETE SECURITY,

ACCIDENT & VIRUS PROTECTION



Failsafe Computer Guardian.™

Complete Protection At A Sensible Price—\$59.95



Guard valuable files and programs. Never again delete or change anything accidentally. Keep out snoops, thieves, vandals. And prevent virus attacks. All at one low price!

- Easy enough to use at home
- Supports DOS, Windows and Networks in one single package
- Indispensable for government, business and power-users
- Allow selective access by user, function or file

Available at leading software stores everywhere!

For more information, call 1-708-433-0500 or Fax 1-708-433-1485

Villa Crespo Software

1725 McGovern Street, Highland Park, Illinois 60035

© 1992 Villa Crespo Software, Inc. • All products mentioned are Registered Trademarks of their respective companies



MADE IN USA

Look for the box with the
Failsafe Beacon™

End Users circle 245; International circle 246; Dealers circle 247 on Inquiry Card

Take the Lead with DataFlex!



Isn't it time you experienced the benefits of object-oriented programming?

You can with DataFlex.

DataFlex's comprehensive 4GL, robust class libraries, object-oriented program generators, and proven database management system provide you with a complete library of tools for application development.

Generating complete object-oriented programs is as easy as clicking on AUTOCREATE in DataFlex's menu system. Utilizing DataFlex's many other language features lets you create fully customized CUA applications.

Experience faster development, easier maintenance, re-usable code, and better looking applications now with DataFlex for \$795.

The benefits of object-oriented programming are here now. Don't get left behind.

Take the lead... with DataFlex!

Features of DataFlex:

- Object-Oriented Programming
- Application Generators
- Relational DBMS
- Portability (DOS, DOS Networks, Unix, Windows)
- Client/Server Solutions

Time Saving Benefits of DataFlex:

- Reusable Code
- Easier Design
- Speed
- Flexibility
- Reliability

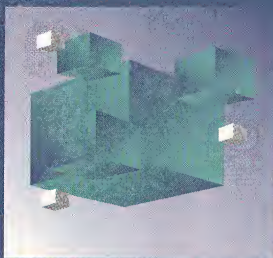
Call 1-800-451-FLEX for complete DataFlex information and the dealer nearest you.

DATA ACCESS
CORPORATION

Miami, FL U.S.A.
305/238-0012

For information via CompuServe: GO DAC

Circle 114 on Inquiry Card



DATA FLEX

Object-Oriented 4GL
Application Development Environment
DBMS

Australia 61-3-699-7044
Austria 43-662-658-2237
Belgium/Luxembourg 49-61-727-5014
Brazil 55-11-872-9266
Canada 416-226-2181/416-785-5041
Chile 56-2-231-7015
Denmark 45-45-76-4545
France 33-1-47-241-961
Germany 49-61-727-5014
Hong Kong 852-311-7922
Italy 39-587-422-022/39-51-437-025
Japan 81-480-856-565
Mexico 525-545-6327

Minsk 7-0172-236797
Moscow 7-095-4342060
Netherlands 31-74-555-609
New Zealand 64-9-772-701
Norway 47-2-559-966
Singapore 65-775-5588
Spain 34-1-402-2298
Sweden 46-300-19530
Tallinn 7-0142-238035
United Arab Em. 97-12-331-885
United Kingdom 44-71-729-4460

Prices may vary by country. DataFlex is a registered trademark of Data Access Corporation.

See us at Comdex/Fall, booth 2376

SIGNALS ON THE DESKTOP

The integration of DSP technology on the desktop is already under way

JOHN BRYAN

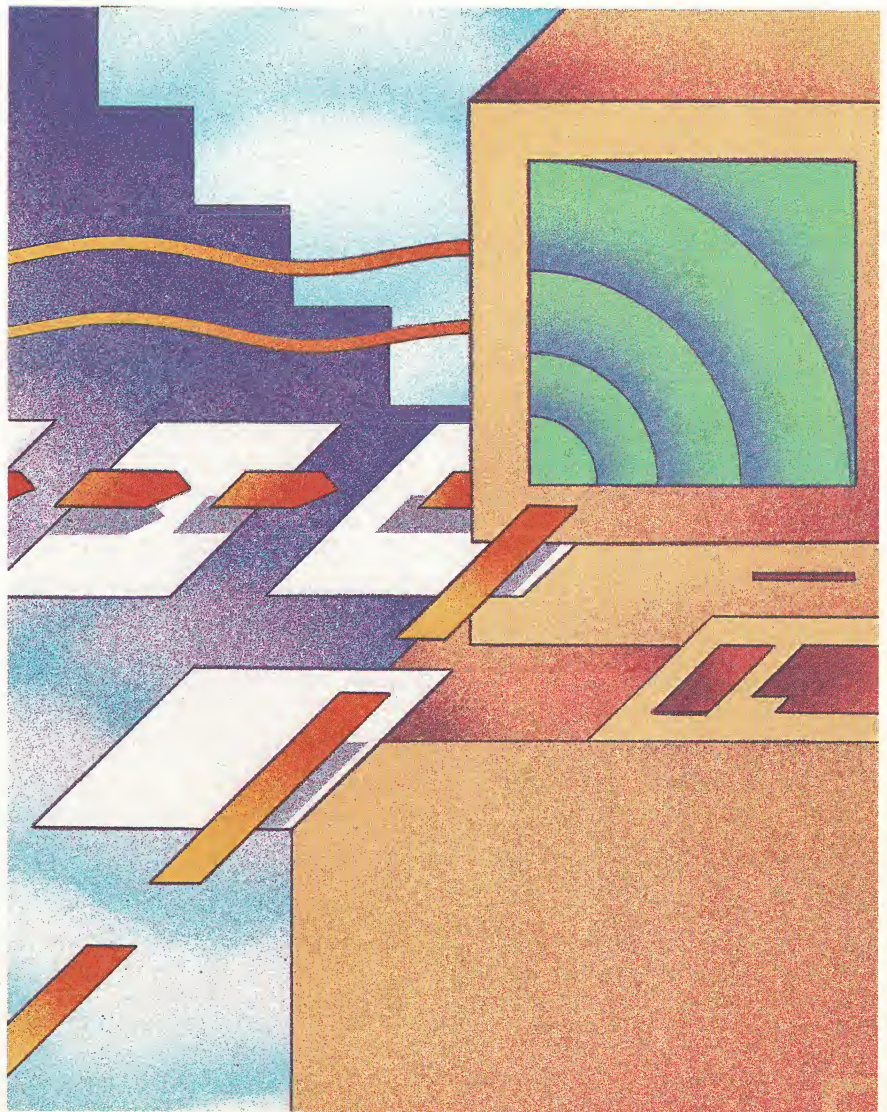
The integration of DSPs (digital signal processors) on the desktop, either as an add-in board or as a part of the motherboard, brings technologies such as continuous speech recognition closer to everyday reality. And programmable, powerful signal processors are being used for various other new applications.

DSP technology has been available for quite awhile, but until now, only specialized applications (e.g., disk head positioning, spectrum analysis, dedicated audio and video processing, and PBX systems) have migrated to personal computers. With recent advances in hardware, firmware, and software, signal processing is moving into desktop applications that will bring excitement to business computing.

The DSP Difference

What is the difference between a standard CPU and a DSP? There are architectural differences, certainly (see "Inside Signal Computing" on page 177), but the fundamental difference lies in the ability of the DSP to handle real-time data streams generated by sampling analog data patterns. By their nature, signals are constantly changing. If a computer is unable to act on the data as it happens, the computational results, if any, will be invalid. So, signal processors must be able to quickly interpret and react to data and perform the necessary calculations, such as multiply and accumulate.

One of the main advantages of integrating a DSP with a standard CPU is that such an arrangement can provide concurrence of signal-processing operations with respect to general computing tasks. A DSP isn't inherently any faster than a similarly



clocked CPU, but DSPs excel at particular functions. The relationship between a DSP and a CPU in a desktop system is analogous to that of a math coprocessor and a main processor. A fixed-point 386 can do all the floating-point calculations that the 387 would normally handle, but the 387 is a lot faster. The same is true for DSPs. For example, for the types of calculations that call for signal processors, Texas Instruments claims that its TMS320C 16-bit fixed-point DSP can deliver three to five times the MIPS of a 386 CPU.

DSP Data

One of the most important facets in determining how to implement a DSP application is ascertaining the sampling rate for data. Speech—at least at the quality you hear over the telephone—is one of the less demanding DSP applications from a processing point of view. A microphone, which is a transducer that converts sound waves into voltage levels, is the most common data source. The data flows into an A/D converter, which produces *samples* of the data 8 bits wide at the rate of 8 KHz, or 8000 times a second. A DSP takes this data stream and performs whatever calcu-

lations the software calls for. The output goes to a D/A converter and then to a speaker, which turns the electrical signal back into sound. If this data goes to disk, it takes up about 8 KB of disk space per second of speech.

ARTA is a multiprocessing system that supports multiple DSPs.

An 8-KB-per-second sampling rate is about as low as you can go and still get decent sound quality. CD-quality sound must be sampled at a faster rate (up to 44 KHz), and the word size of the sound bytes should be 16, 24, or 32 bits. Storage re-

quirements scale accordingly, with typical high-quality stereo sound taking up to 176 KB per second of sound.

Sound is a lightweight in the consumption of storage capacity. Real-time video can require as much as 1 MB per second, which quickly fills up a 40-MB hard drive. In fact, one of the primary uses of the DSP in an application is the compression/decompression of the data stream as it moves onto and off of the disk.

Given that DSPs are adept at handling speech and video data, it's not surprising that the prime motivation for using DSPs in personal computers is multimedia applications. In fact, without DSPs, true multimedia would remain a pipe dream, because general-purpose CPUs just don't have the horsepower to handle multimedia data effectively.

DSP on the Desktop

Next (Redwood City, CA) was the first major system manufacturer to recognize the value of bringing DSP technology to the desktop. It has included DSP hardware and the necessary operating-system support in every workstation it has produced. Next uses the Motorola 56001, a 24-bit

DATA COMPRESSION LIBRARIES™

PKWARE's® Data Compression Libraries™ allow software developers to add data compression technology to software applications. The application program controls all the input and output of data allowing data to be compressed or extracted to or from any device or area of memory.

- All Purpose Data Compression Algorithm Compresses Ascii or Binary Data Quickly with similar compression achieved by the popular **PKZIP** software, however the format used by the compression routine is completely generic and not specific to the PKZIP file format.
- Application Controlled I/O and memory allocation for extreme flexibility.
- Adjustable Dictionary Size allows software to be fine tuned for Maximum Size or Speed.
- Approximately 35K memory needed for Compression, 12K memory needed for Extraction.
- Compatible with most popular Languages: C, C++, Pascal, Assembly, Basic, Clipper, Etc.
- Works with any 80x86 family CPU in real or protected mode. \$295.00
- No runtime royalties.

RUNNING OUT OF EXPENSIVE DISK SPACE?

PKZIP can help! **PKZIP** compresses your files to free up disk space and reduce modem transfer time. You can compress a single file or entire directory structures with a single command. Compressed files can be quickly returned to their normal size with **PKUNZIP**.

Software developers can reduce the number of diskettes needed to distribute their product by using **PKZIP**. Call for Distribution License information. *See us at Comdex, Booth S486*

The included **PKZIP** utility lets you store compressed files as a single self-extracting .EXE files that automatically uncompresses when run. Only \$47.00



9025 N. Deerwood Dr.
Brown Deer, WI 53223
(414) 354-8699
Fax (414) 354-8559

BY1192

▶ FrameMaker.

The ultimate Interleaf® “upgrade.”



Year after year you Interleaf users hoped for a newer, friendlier, better publishing solution—and what you got were promises.

- ▶ What you ought to get is FrameMaker.®
- ▶ With FrameMaker you'll get a document publishing program that's powerful, fully featured, and fully integrated—like Interleaf. But not fully frustrating—like Interleaf.

- ▶ You'll get a familiar, well-behaved user interface that increases your productivity, instead of a proprietary interface that increases your confusion. You'll get accessible, intuitive tools like FrameMaker's Conditional Text, instead of cumbersome, procedure-intensive nightmares like Interleaf's "Effectivity."

- ▶ You'll finally get files that are truly compatible—across all the major desktops and across future upgrades. Instead of Interleaf version 5 on your Sun™ that can't

be handled by Interleaf version 3 on your Macintosh.

- ▶ You'll get the same compatibility with FrameViewer,™ Frame's leading edge viewing technology that lets you distribute FrameMaker documents—or even converted Interleaf documents—electronically. So everyone in your organization can receive up-to-the-minute, accurate information on-line.

- ▶ And if you act quickly you'll get an even easier upgrade deal: a **free** Interleaf-to-FrameMaker file conversion filter*—a \$995 value.** Call **1-800-U4-FRAME Ext. 233** today for more information. And this time upgrade for good.




Frame®



processor with expandable local RAM, to support the multimedia efforts of their ISVs (independent software vendors). Next's object-oriented NextStep operating system also includes objects for audio and video data manipulation, ISDN telephony, CD sound (you can listen to your favorite music while you're computing), and other functions.

Another system manufacturer with a commitment to using DSPs is Apple (Cupertino, CA). Apple has always empha-

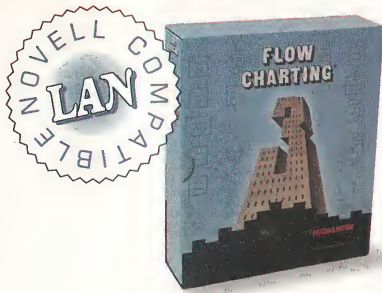
sized the value of quality sound in a computing environment, but it has only recently announced its intention to integrate a full-fledged programmable DSP into the Mac platform. Apple started the project in 1987, and after trying synthesis chips, phase-locked loops, and static-program DSPs, the company finally decided that it needed a fully clean, 32-bit, big-endian, byte-addressing processor (e.g., the 68030 and the 68040).

Apple has teamed up with another in-

dustry giant, AT&T, to produce ARTA (Apple Real-Time Architecture), a real-time multitasking and multiprocessing signal-processing extension for the Mac. The goal of this DSP architecture is to provide a scalable standard platform for most types of signal processing, including speech, sound communications, image processing, and music.

ARTA features the AT&T DSP3210 processor, which is a fully programmable 32-bit DSP with on-board cache and a 32-bit bus to local static RAM or to page-mode DRAM. The DSP3210 is capable of clock rates of up to 66.6 MHz. ARTA's kernel is only 512 words (2048 bytes) and takes up one-quarter of the DSP3210's on-chip memory.

ARE YOU SPENDING TOO MUCH TIME DRAWING FLOWCHARTS? YOU NEED FLOW CHARTING™ 3.



Every day, professionals worldwide save time and money using Flow Charting 3. It's fast, efficient, easy to use, and always produces presentation-perfect charts and diagrams.

With Flow Charting 3's built-in flexibility, you can create customized charts using a variety of shapes, lines, and text—placed where you want them.

Plus, Flow Charting 3 is now available in a LAN version. Making it easy to share files and set up work groups for specific projects.

And it's backed with free technical support and a 90-day no-risk guarantee. So if you're spending too much time drawing charts, call for a free demo and see for yourself what makes Flow Charting 3 the best-selling flowcharting software.

See your dealer today! Or for a free interactive demo disk, call 1-800-525-0082, ext. 112
International: 408-778-6557, ext. 112

Novell is a registered trademark of Novell, Inc.

PATTON & PATTON
Software Corporation

Excellence in charting the flow of ideas!

Patton & Patton Software Corp. 485 Cochrane Circle, Morgan Hill, CA 95037

DSP desktop applications

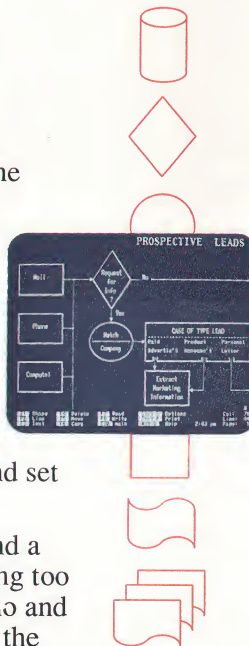
- data compression/decompression
- data communications
- speech recognition
- speech synthesis
- sound synthesis
- image processing

The platform's software component is composed of two parts. The host portion takes care of management functions, and the DSP portion performs real-time data-stream processing.

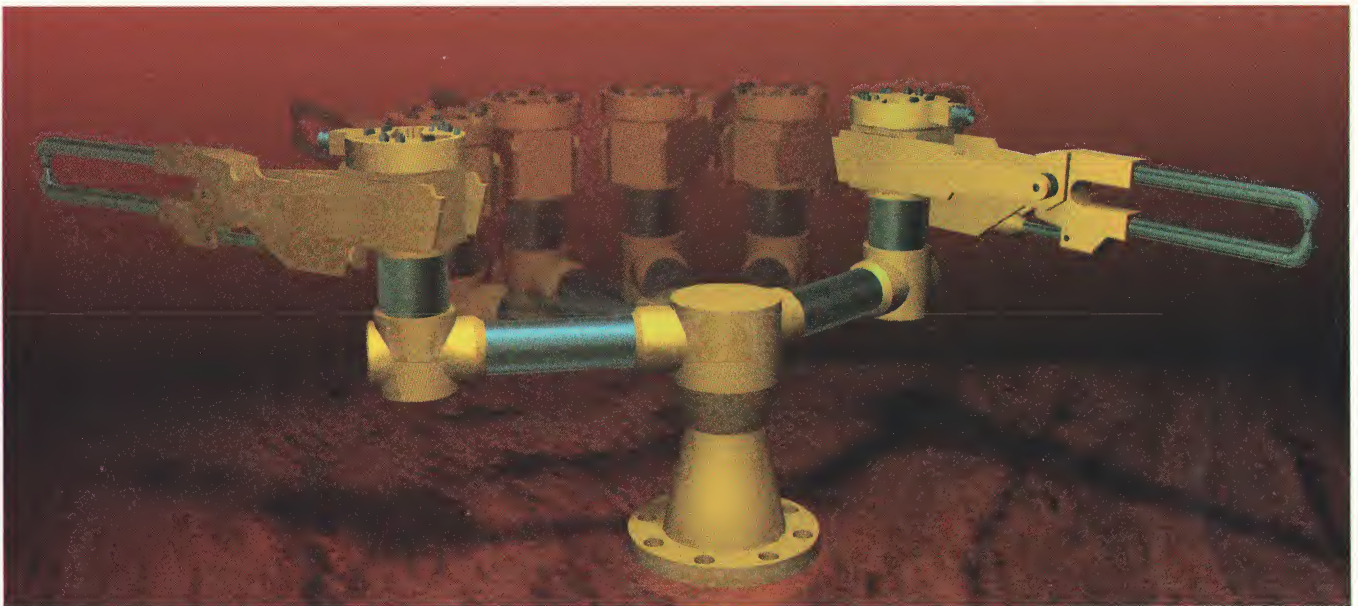
ARTA is actually a dual API system. In System 7.0, developers work with the API Toolboxes, which use drivers that link to the hardware of the Mac. For DSP applications, there is the DSP Module (a toolbox equivalent), which links the DSP kernel to the DSP hardware. With this dual-API system, the DSP programmer can write code without knowing or using any Mac code, and the Mac application developer can produce software that takes advantage of the DSP without knowing or using any DSP-specific code.

ARTA is a multiprocessing system that supports multiple DSPs. Apple will supply DSPs only as a part of the motherboard, not as NuBus cards, although it will license ARTA to NuBus developers. Applications developed under license from Apple will operate seamlessly within the ARTA environment. And Mac systems with integrated DSPs will be available next year.

Apple has an array of uses planned for ARTA. Besides digital audio functions (e.g., compression, noise reduction, and



These are typical AutoCAD drawings.



(In 3D Studio.)

Even the most technical AutoCAD® drawings become dangerously seductive with Autodesk® 3D Studio® Release 2. 3D Studio software seamlessly imports your AutoCAD DXF™ files and turns them into captivating presentations. You can add photorealistic textures, reflections, light and shadows. Or effortlessly change perspective. It's also easy to add motion, for detailed product demonstrations, architectural walk-throughs or fly-bys. Can such a revolutionary creative tool be mastered easily by AutoCAD users? Of course: 3D Studio is made by Autodesk, the makers of AutoCAD. It even comes with a free CD-ROM packed with 500 megabytes of backgrounds, textures, and 3D objects. So you can get up to speed quickly. Want proof? For \$9.95* we'll send you an eye-opening video that shows how 3D Studio helps you sell your best work. Or we'll send you more information, free. Just call 1-800-879-4233, ext. 221. Outside U.S. and Canada, fax 415-491-8303.



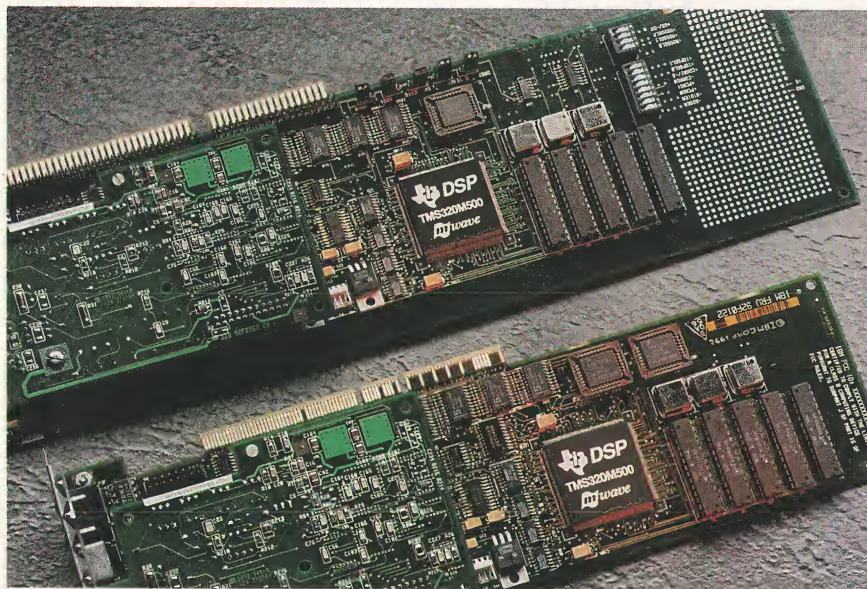


Photo 1: MWave is a collaborative effort by IBM, Texas Instruments, and Intermetrics to produce a DSP board for the PC. The heart of MWave is TI's TMS320M500 DSP chip, which delivers 17-MIPS performance in a 16-bit data fixed-point package.

mixing), Apple plans to promote the development of speech and communications programs. Speaker-independent speech synthesis and speech recognition are an exciting step toward creating the first truly user-friendly human-computer interface. With this feature, a computer could tell a novice user, in English or in any other language, exactly how to set up the system to best suit the environment and proposed uses. Other possible applications are voice-edited documents, video telephones, video- and audio-enhanced software installation, and presentation and education software.

Twin Peaks

In addition to working with Apple on the Mac platform, AT&T has also come up with a DSP solution for MS-DOS computers. VCOS (Visible Caching Operating System), AT&T's operating system for the DSP3210, is multitasking and resides in the memory local to the signal processor. Developers can use the VCOS and VCAS (Visible Caching Application Server) modules to integrate AT&T's DSP technology into general-purpose computing systems. And VCOS relieves applications programmers and system integrators from having to deal with the complexities of DSP programming.

Not to be outdone, IBM (Armonk, NY) has also announced its intentions to get into the personal computer DSP market. IBM has formed an alliance with Texas Instruments and Intermetrics, a software

development company, to bring out a product called the MWave (see photo 1). IBM will first be producing a plug-in board for the ISA or Micro Channel architecture bus, but it also has plans to produce PS/2 systems with DSP technology on the motherboard by mid-1993.

TI engineered the DSP chip used in the MWave. The TMS320M500 delivers 17-MIPS performance in a 16-bit data fixed-point package. The processor has seven lines for serial data input and a bus data line (which is host-specific) and multi-channel DMA for all I/O. Although the chip deals with 16-bit data, the program memory bus is 24 bits wide. The DSP is integrated into a board that includes a MIDI port, a UART (universal asynchronous receiver/transmitter), stereo A/D converters, and telephony AIC interfaces.

TI will develop an OEM distribution channel for the MWave, offering it to systems manufacturers for integration into their motherboards. At this fall's COMDEX, TI was scheduled to announce a DDK (Driver Development Kit) with sample drivers for speech, audio, and telephony.

Operating-system support is provided by IBM, whose Burlington, Vermont, product group developed a multitasking operating system for the MWave project. This embedded operating system, the MWave DSP manager, sits on top of OS/2 or Windows and can handle functions like JPEG (Joint Photographic Experts Group) video compression, voice recognition, data and fax modems, echo cancellation, music,

and text-to-speech conversion.

The MWave DSP manager is a virtual device driver that provides a high-level API for digital signal processing in either environment. This API is the platform that provides a socket for device drivers. IBM wants to use this technology to increase desktop functionality—integrating the fax, telephone, dictation machine, and other office appliances into the PC.

IBM's objective is for this product to become as pervasive as the math coprocessor. For this to occur, application development will have to proceed at a pace with the development of support hardware. To further this end, IBM is out to enlist the support of major software development houses, such as Microsoft, Borland, Lotus, and WordPerfect.

To support the creation of all these applications, Intermetrics was tagged to come up with the development tools for the programmer. What it's providing is a standard ANSI C software development kit, complete with language, compiler, assembler, debugger, and a set of programming tools that are generic to the world of C programmers. A provider of DSP applications for the space-shuttle program, Intermetrics has been in the business of developing system application software for embedded systems for 23 years (until recently, most DSP applications were implemented in embedded systems).

One of the more helpful tools in the MWave environment is a nice visual debugger that enables you to trap signals coming in to the DSP in real time and observe their interaction with the host application. Intermetrics will provide one set of tools for Windows and another for OS/2.

DSP and Communications

Besides the major systems vendors, other companies, of both hardware and software orientation, are in the desktop DSP market. Many of them, especially the software firms, create products for Next workstations, mainly because Next has had integrated DSP support longer than anyone else. But many vendors have produced hardware/software solutions to specific vertical markets (e.g., radar research or digital instrumentation) for both the PC and the Mac platforms, and many more are moving in this direction, as DSP technology becomes more of a standard than a standout.

This year, Hayes Microcomputer Products (Atlanta, GA) announced the Hayes ISDN Extender, a network-interface module that provides ISDN Basic Rate Access and analog telephone-line connectivity to Next computers. The ISDN Extender can be used for remote LAN connections and

Welcome to Open Country.

If you've been hankering to move to open systems, there's good news. CICS™, the world's most popular online transaction processing (OLTP) program, now runs on the RISC System/6000®. With CICS/6000™ for AIX®, IBM's enhanced version of UNIX®, you'll discover the flexibility of open distributed computing using the same investment you've already made in training and applications on your mainframe CICS.

Nobody knows OLTP or distributed processing like IBM, and with our support and service, you'll never feel lost in the wilderness. IBM also offers Encina™, an exciting new OLTP product for multivendor distributed environments.

We're also introducing the new RISC System/6000 Models 580 and 980, the perfect partners for your open computing needs. Both provide leading price performance that's not a kick in the head.

Call your IBM marketing representative or Business Partner. For literature, call 1 800 IBM 6676, ext. 723*. We think you'll have only one thing to say.

Yippee.

Introducing CICS/6000.

- Leverages your investment in CICS
- Interoperability for PCs through mainframes
- Built on OSF's™ DCE
- Introducing the RISC System/6000 Models 580 and 980

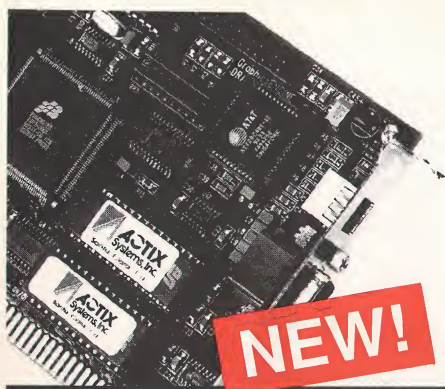


Circle 513 on Inquiry Card.

RISC System
/6000



*In Canada, 1 800 465 1234. IBM, AIX and RISC System/6000 are registered trademarks and CICS and CICS/6000 are trademarks of International Business Machines Corporation. All other products are trademarks or registered trademarks of their respective companies. © 1992 IBM Corp.



GraphicsENGINE 32:

Windows Users...

20X Faster Windows!

Now Only
\$189

Thru Dec 31 '92
reg. \$229

- ✓ Faster Windowing
- ✓ Speed Scrolling
- ✓ Quick Page Graphics
- ✓ 16.7 Million Colors

Quality Graphic Accelerators

- High Performance Windows and CAD applications ■ 72HZ Refresh Rate for Flicker-Free screen capabilities ■ One-year repair/replace policy



Order Now!

Government and
Corporate PO's welcome.
VISA or MASTERCARD

800 927 5557

SIGNAL COMPUTING



Photo 2: The Lightning Effects I Macintosh accelerator from Spectral Innovations targets specific applications. This product provides enhanced performance for image-processing applications.

high-speed digitized voice, data, and fax modem, as well as other multimedia functions (e.g., video transmission).

Ariel (Highland Park, NJ) is another vendor that has concentrated its efforts in the Next market, for which it makes a wide range of products, from the \$500 Digital Microphone to the \$15,000 IRCAM signal-processing workstation. Even though the Digital Microphone, ProPort, and DAT-Port all deal specifically with CD-quality sound and use the Nextstation's own Motorola DSP56001 DSP, the IRCAM and the QuintProcessor each feature their own DSPs. The QuintProcessor contains five 27-MHz 56001 DSPs, four of which handle DSP functions while the fifth manages on-board memory, storage, and interprocessor communication. The IRCAM uses two Intel 860 RISC processors to provide a parallel-processing environment, with a 56001 DSP for data I/O. The IRCAM also comes with its own operating system, CPOS.

Metaresearch (Portland, OR) is a software firm whose products Digital Ears, SoundWorks, and Color Digital Eye can be used creatively in multimedia presentations. SoundWorks is essentially a sound mastering board, a digital version of the professional mixing board that you might find in any recording studio. Digital Ears is

a stereo digitizer that captures CD-quality sound for the Next. And Color Digital Eye is a video frame grabber for entering and editing video images.

Another company that concentrates on sound, music, and professional recording is Digidesign (Menlo Park, CA). Digidesign has been producing products for the Mac for three and a half years, although it does not target the Mac user as much as the recording engineer or broadcast professional. Its three products (Audio-media II, Sound Tools II, and Pro Tools) combine the Motorola 56001 with high-end software to do stereo or multitrack recording and mixing functions (e.g., compression, waveform editing, equalization, chorusing, echo, and pitch shifting). They can also do SMPTE (Society of Motion Picture and Television Engineers) synchronization.

Processing Pictures

Giga Operations (Berkeley, CA) is a start-up company whose aim is to develop a low-cost, massively parallel digital signal-processing board for desktop computer systems. GigaOps uses the Analog Devices 2105 DSP, a 16-bit processor rated at 10 MIPS. Giga Operations puts four 2105s, 1 MB of DRAM, and a Xilinx PGA (Programmable Gate Array) into a single

Dynamite Comes in a Small Package...



Voice*

Caller ID*

14,400 bps FAX

\$399⁹⁵

14,400 bps DATA

5 Year Warranty

Never before has so much power & technology been packed into a SupraFAXModem! The SupraFAXModem V.32bis combines a *potent* mix of fax and data features — for *explosive* results! Maximum fax potential is achieved with Group 3 fax machine compatibility at up to 14,400 bps and Class 1 & 2 software compatibility. With raw data speeds from 300 to 14,400 bps, and up to 57,600 bps

with V.42bis compression, it *blasts* data over telephone lines. Plus its revolutionary display gives you 25 different status reports! For just a little more, you

can add caller ID and voice capabilities later this year.

All this for the *dynamite* price of \$399.95! In add-

ition to the stand-alone version (without software) SupraFAXModems are available in

Windows™, DOS™, and Macintosh™ packages.

SUPRA FAX MODEM
V.32bis



Supra Corporation®

9600 bps Version
\$299⁹⁵

Circle 234 on Inquiry Card.

1-800-727-8647



NOW SHIPPING

* Low-cost, user-installable Voice & Caller ID upgrades available Q3 '92 • All trademarks belong to their respective companies.

surface-mount module called a SIIMOD (Scalable Intelligent Image Module). Each of the SIIMODs provides 40 MIPS of signal-processing power. The end product, an ISA bus card called the T-800, supports up to eight of these modules, for a total power throughput of 320 MIPS, with 32 DSPs and 8 MB of RAM. With four cards in one system, the total processing power becomes 1280 MIPS, hence the company name.

Giga Operations is targeting the image-

processing market. Its long-term goal is the execution of real-time math-intensive image processing at the read/write rate of a fast hard drive. To do this, it provides a proprietary C compiler called the Stream Splitter, which takes the serial data stream of signals and converts them for operation in parallel mode. One of the slick features of the T-800 is that the PGAs allow the user code to dynamically configure the board in real time (on the order of microseconds). Thus, alternative virtual ma-

chines can in parallel take advantage of resources as they are required.

Spectral Innovations (Santa Clara, CA) has been making DSP accelerator cards for the Mac since 1988. Like ARTA for the Mac, its cards use AT&T signal processors. But unlike Apple, the company makes a NuBus card with separate software modules for a variety of DSP functions (see photo 2).

In the past, Spectral Innovations focused its attention on the technical marketplace (e.g., signal analysis), but now it's in the process of producing more mainstream application modules. It intends to announce a fax/modem/telephony module by the end of the year, and it has a number of other projects in the works. The company provides a development environment with each card, and other vendors have made modules that use their hardware to accelerate Adobe Photoshop, LabView, IPLab, and MatLab.

From a consumer's point of view, one of the terrific things about the integration of DSP technology onto the desktop is that each function—whether it is audio, video, modem/fax, or some other tool—essentially exists as a virtual machine. The underlying hardware does not change while the application software creates the product. Besides keeping the cost down by reducing the number of pieces of hardware you must buy to accomplish various tasks, this could also reduce the size of the host system, especially as DSPs are integrated onto the motherboard. This also simplifies the upgrade process, because vendors need only send another disk to fix bugs or provide new functions.

Forging Ahead

CPUs are not up to the task of working with audio and video data. There are just not enough MIPS available. For now, the best way to handle multimedia data is to add a DSP to your system. You will see more system and peripheral vendors adding DSPs to their products in the coming year.

The logical next step, of course, is the integration of a DSP into general-purpose microprocessors. With advances in chip integration and with the 80x86-architecture vendors trying to differentiate their products from their competition, the addition of DSP functionality to an industry-standard CPU is inevitable. In many ways, DSPs are poised to become the math coprocessors of the 1990s. ■

John Bryan is a freelance technology writer and consultant based in San Jose, California. You can reach him on BIX c/o "editors."

Turn CodeView® or Turbo Debugger® into an "ICE"

...at a fraction of the price!

When your debugging needs go beyond what your current software can handle, you can now add the extra horsepower you need.

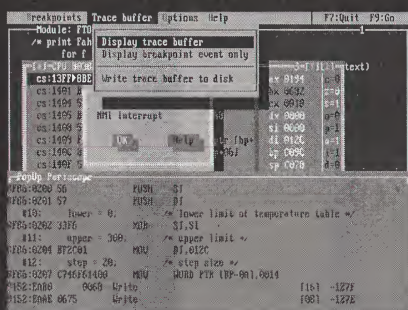
How? Just **PopUp Periscope!** Periscope® Model IV's new popup software gives you easy access to its hardware *while* you use your favorite software debugger. You can capture a true system history with absolutely no slowdown. And set sophisticated real-time hardware breakpoints. You'll have an "ICE" as comfortable to use as the debugger you already know, for a lot less than you'd expect.

Be ready for any debugging crisis—CALL TOLL FREE:

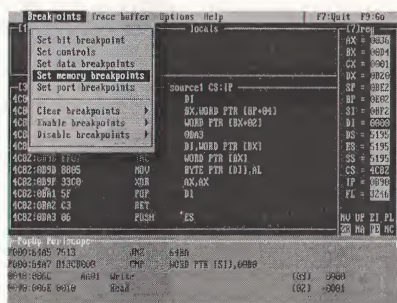
800/722-7006

You can *rent* Model IV for as little as \$9 a day (minimum one month).

*CodeView is a registered trademark of Microsoft Corporation. Turbo Debugger is a registered trademark of Borland International, Inc. Periscope is a registered trademark of The Periscope Company, Inc.



The PopUp Periscope software currently supports Turbo Debugger (shown above) and CodeView (shown below).



Periscope Model IV is available for systems with 286, 386DX, 386SX, 486DX, and 486DX2 CPUs running up to 33 MHz.



1197 PEACHTREE ST., PLAZA LEVEL
ATLANTA, GA 30361 • 404/875-8080
FAX 404/872-1973

SOFTLINE. THE BEST BUYS IN OVER 170 COUNTRIES.

SOFTWARE

* (Items in RED run under Windows)

Word Processors/Editors

Ami Pro 2.0	\$307
Brief 3.1	169
Foxgoblin 1.0	101
Grammatik IV 2.0	58
JustWrite 2.0	166
Microsoft Word 2.0 for Windows	319
Microsoft Word 5.5	223
WordPerfect 5.1 for DOS	274
WordPerfect 5.1 for Windows	282
Wordstar 7.0	274

Project Management

Microsoft Project 3.0 f/Windows	461
Superproject 2.0	550
Timeline 1.0	465

Database & Tools

Askson 5.0	219
Btrieve 5.10 for DOS	414
Btrieve 5.10 for OS/2	405
Btrieve 5.10 for Windows	412
Ctree Plus 1.0	451
Clonix Professional Level 2.1	468
Clipper 5.01	519
Dolbase 4.24	538
Dbase IV 1.5	504
Dbase IV Developer Edition 1.1	899
dbase/Windows 1.7C	397
DBXL 1.3R	133
Foxpro 2.0	489
Paradox 2.0 for OS/2	518
Paradox 4.0	514
Q&A 4.0	265
Rbase 3.1	483
Rbase 3.1 for OS/2 1-3 User	554
Superbase 4 Windows rel 1.3	480

Statistics

SPSS PC+ Adv Statistics 4.0	254
SPSS PC+ Base Package 4.0 (DOS)	168
Statgraphics Plus	981

Desktop Publishing

Adobe Type Manager 2.0	563
Aldus Persuasion 2.1	335
Aldus Photostyle 1.1A	537
Arts & Letters Graphics Ed 3.12	342
Focus 1.2	60
Microsoft Publisher 1.0	132
Pagemaker 3.01 for OS/2	532
Pagemaker 4.0	532
Perform Pro Design+Filler 1.0	182
PFS:First Publisher 3.0	89
Publishers' Type Foundry 1.5	322
Ventura Publisher Gold 4.01	537

Graphics

Adobe Illustrator 1.1	369
Adobe Streamline 1.1	124
Apploze II 1.5	353
Charisma 2.1	335
Corel Artsworx '91 - CD NA	43
Corel Draw 2.0 for OS/2	384
Corel Draw 3.0	384
Designer 3.1 for OS/2	472
Designer 3.1 for Windows	427
Drafix Cod for Windows 2.0	428
DrawPerfect 1.1	292
Freelance Graphics 1.0 for Windows	360
Freelance Graphics 4.0 for DOS	335
GEM/3 Presentation Team 2.0	337
Harvard Draw 1.0	424
Harvard Graphics 1.0 for Windows	327
Harvard Graphics 3.0	413
Hipok 1.0	124
Microsoft Powerpoint 3.0	327
Windows Draw 3.0	101

Spreadsheets

Lotus 1-2-3 rel 1.1 for Windows	427
Lotus 1-2-3 rel 2.4	354
Lotus 1-2-3 rel 3.1+	428
Lotus 1-2-3 for OS/2 1.1	513
Microsoft Excel 4.0	322
Quattro Pro 4.0	324

Desktop Environments

Designview 386 2.4	\$133
HP New Wave 3.0	108
Microsoft Windows	95
Sidekick 2.0	58

Project Management

Microsoft Project 3.0 f/Windows	461
Superproject 2.0	550
Timeline 1.0	465

HARDWARE

Display Boards

ATI Graphics/Ultra w/1MB (PCA)	\$488
Diamond Stealth VRAM w/1MB (PCA)	267
Hercules Graphics Stn w/1MB(PCA)	489
Orchid Fahrenheit 1280 w/1MB(PCA)	297
Paradise Acel Crd f/Win w/1MB	217
STB Wind/X Ultra w/1MB (PCA)	296
Video 7 WIN.VGA w/1MB (PCA)	171

Emulation Boards

AST 5251-11 Enhanced Plus	505
DCA IRMA 3 Convertible (PCA)	430
Xircom Pocket 3270 Adapter f/Win	551

Facsimile Hardware

Boca BocaFax 9624 Internal (PCA)	79
Complete PC Fax Communicator	309
Complete PC Fax Port (9600)	309
Intel Satisfaction Classic (PCA)	338
Megahertz Fax/Modem 96/96 S/R Ext	495

Printers & Accessories

Canon Bubblejet Printer BJ10EX	354
HP Deskjet 500C Color Printer	756
HP Laserjet III	1,627
HP Pointjet Color Printer	756
Pacific 25-In-One (all HP models)	273
Pacific 2MB Exp (2P, 3P, 3D)	131
Pacific 4MB Exp (2P, 3P, 3D)	221
PacificPage PS Cart(2P/D, 3P/D)	298

Multimedia

Asymetrix Multimedia Toolkit-CD 1.5	\$513
MS Multimedia Beethoven - CD 1.1	53
MS Multimedia Bookshelf - CD 1991 Ed	129
MS Multimedia Dev Kit - CD 1.0	320

OCR

Omnipage Pro 2.1	661
Readlight 2.01	305
Wordscan Plus 1.1	667

Network Interface Cards

3COM Etherlink II TP 16 bit (PCA)	\$175
3COM Etherlink II TP 16 bit 5 Pk	748
ADIC DCE Bsk Coprocessor Bd Ch1	322
Eagle NE1000 8bit Ethernet (PCA)	131
Eagle NE2000 16bit Ethernet (PCA)	162
Eagle NE3200A 32-bit Ethernet(EISA)	698
Eagle Ntwrke Lite Add Kit NE2000	215
Eagle Ntwrke Lite Strt Kit NE2000	422
Proteon ProNet-4/16 Busmstr (PCA)	516
SBC PC600FS Arcnet Serv 16bit CX	205
SBC PC600FS Arcnet Wkstn 16bit CX	127
Tom Conrad Ethnt 10base-T 10 Pk	1,355

Scanners & Input Devices

Logitech 2-Button Set Mouse w/Win	71
Logitech Trackman Serial	54
MS Ballpoint Mouse	125
MS Bus Mouse w/Pointbrush	105
MS Bus Mouse w/Win 3.1	156
MS Ser Mouse 5-Pck	383
Summa Summuskeytel II 12x12 16bit	345
Thumbelino Portable	63
Core Typist+ Graphics OCR Scnr	391
HP Scanjet IIP w/Interface (PCA)	914
Logitech Scanman Mod 256 (PCA)	273
Logitech Scanman Mod 32 (PCA)	137

Languages & Programming Tools

ABC Flowchart 1.13	\$182
Asymetrix Toolkit 1.5	291
Borland C++ 3.1	338
DR DOS 6.0	67
Interactive Easyflow 7.0	193
MS Basic Comp 7.1 (DOS/OS/2)	328
MS C with C++ 7.0	327
MS C++ 4.5 (DOS/OS/2)	595
MS Device Driver 3.1 f/Windows	132
MS Pascal Comp 4.0 (DOS/OS/2)	399
MS Quick C 1.0 for Windows	132
MS Visual Basic 1.0 f/Windows	330
MS Windows SDK 3.0	48
MS-DOS 5.0 (generic)	59
MS-DOS 5.0 Upgrade	105
Objectvision 2.0	105
Turbo C++ 3.1 for Windows	105
Turbo Debugger & Tools 2.0	105
Turbo Pascal 1.5 for Windows	121
Zortec C++ 3.0 (DOS/WIN/OS/2)	465
Zortec C++ & Eng 3.0 (D/W/O)	664

Integrated Packages

Lotus Symphony 2.2	505
Lotus Works 3.0	92
Microsoft Works 2.0	99
Wingz for PC 1.1A	320
WordPerfect Works 1.0	94

Network/Multisuser

Novell NetWare 2.2 10 User	1,170
Novell NetWare 2.2 50 User	2,343
Novell NetWare 3.11 10 User	1,481
Novell NetWare 3.11 100 User	4,152
Novell NetWare 3.11 20 User	2,049
Novell NetWare 3.11 5 User	70
PC-MOS 4.1 - 5 User	459

Productivity Tools

Don Briddins Demo II 3.0	201
Microsoft Money 1.0	46
Microsoft Office 2.5	496
Microsoft Productivity Pak 3.1	40
On Target 1.0	265
Pocket 4.0 for Windows	243

Communications

Carbon Copy 1.0 for Windows	\$133
Close-up Customer/Terminal 3.0	123
CrossTalk 3.0 for Windows	120
Dynacomm Term Emul Asynchronous	141
Microcouniter 1.0	67
Procomm Plus 1.0 for Windows	82
Procomm Plus 2.01	70
Relay Gold 5.0	175
Smartman 240 3.1	207
Winconnect 1.0A	61
Winfax Pro	74

Utilities

386 Max Pro 6.01	61
Back-it 4.1.0	53
Central Point Antivirus 1.3	84
Central Point Backup 7.1	84
CheckIt 3.0	83
Fastback Plus 3.0	122
HDC Icon Designer 2.0	33
Logiplex Pro	104
Microsoft Windows Debugger 3.1	130
Norton Antivirus 2.0 (DOS/Win)	85
Norton Backup 2.0 (DOS/Win)	86
Norton Desktop 1.0 for DOS	118
Norton Desktop 2.0 for Windows	99
PCTOOLS 7.1 (DOS/Windows)	112
QDOS III Gazette 1.0	43
QEMM 386 Exp Mem Mgr 6.01	61
Shocker 2.0	86
Super PC-Kwik 4.1	47
Superstar 2.0	78
Xtree Gold 2.5	97

Workgroup/Group Productivity

CC-Mail 1.0 Windows Platform Pk	343
CC-Mail 3.2 - 8 User Pck	136
CC-Mail 3.2 MS-DOS Platform Pck	889
MS PC Mail 2.1 - 20 User Lic Pk	129
MS PC Mail 2.1 Remote Wkstn	459
WordPerfect Office PC 3.01	89

Please call for items not listed

SOFTLINE MAKES BUYING AS SIMPLE AS ...

1.

Ordering



Fax your order & inquire to us 24 hours a day

1-718-438-2315



Call us at

1-718-438-6057

(9:00 to 17:00 U.S. EST, Mon.-Fri.)

All prices and payments are in U.S.D., and do not include shipping, insurance, and other fees. VAT and duties will be collected at delivery. Please confirm prices, availability, shipping costs and other fees at time of order. Please specify 3 1/2" or 5 1/4" diskette size.

2.

Shipping



Ask for Federal Express, DHL or UPS,

if you want 2 to 4 day service through customs to your door.



For large orders, we also ship via economic Air Freight, with 1 week delivery. Please confirm shipping costs when placing your order.

3.

Payment



For fastest Ordering,

use your Visa, MasterCard, American Express, or EuroCard. Simply provide us with your credit card number, expiration date, shipping and billing addresses when ordering. A 3% surcharge is added.

Or you can...

Wire Transfer funds directly to our account at Manufacturer's Hanover Trust (ABA# 021000306) 4901-13th Ave., Brooklyn, NY 11219 Account No. 1042063596065. Please add \$15.00 wire transfer fee and applicable shipping charges. Allow 1 week for confirmation of transfer.



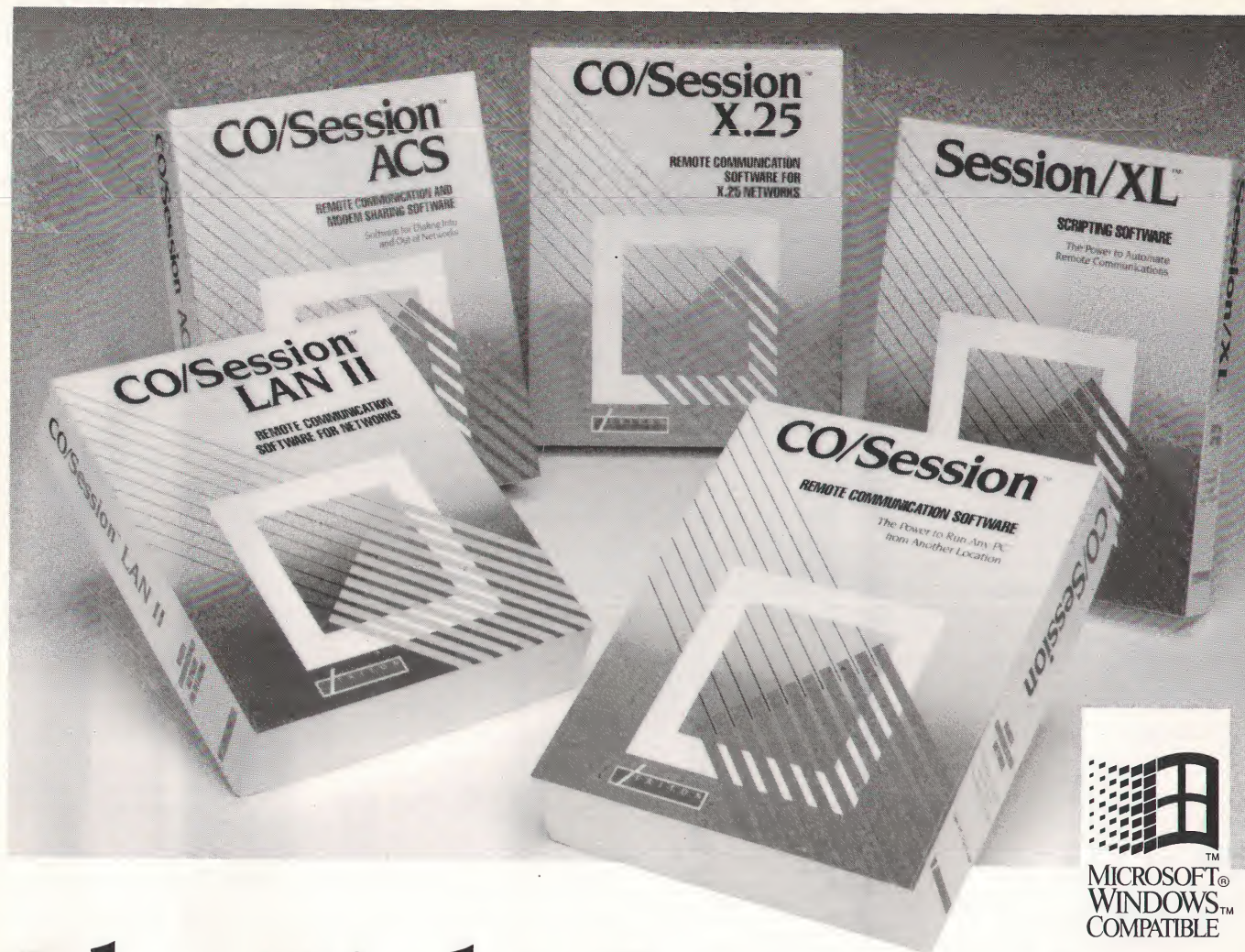
We accept bank checks in US Dollars payable on a US Bank. Send your order with payment.

TERMS: All prices are subject to change without notice. We do not charge your credit card until your order is shipped. All returns require prior authorization and RA number from our customer service department. (Minimum 20% restocking fee on returns). All returns are to be shipped prepaid and insured.



Softline International Division

1333 60th Street, Brooklyn, NY 11219 FAX: 1-718-438-2315



The Right Connections

for all of your communication and networking needs

CO/Session™...fast remote computing

PC Magazine's Editor's Choice (February 25, 1992) in remote computing for DOS and Windows applications. With unbeatable graphics and response speed in DOS and Windows, it's ideal for remote access to distant PCs and networks, or to support users at distant locations. LAN Magazine's 1991 and 1992 Product of the Year!



February 25, 1992
CO/Session, Version 6.01

CO/Session ACS...advanced modem sharing software

The low cost modem sharing solution for dialing into and out of networks. Share modems without dedicating PCs. Remote control, terminal emulation and file transfer software is included. Or use your own favorite third party communication software that supports Interrupt 14 such as PROCOMM™ PLUS LAN or Crosstalk™.

CO/Session LAN II...essential for network support

The perfect tool for network administrators to support all LAN workstations. CO/Session LAN II includes full support for both DOS and Windows with exceptional performance.

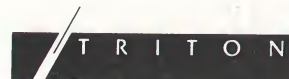
CO/Session X.25...the only remote computing package for X.25 networks

Offering world-wide communications, CO/Session X.25 provides remote access, terminal emulation and automated file transfer between PCs over X.25 wide-area networks.

Session/XL...automated communications made easy

Create custom scripts to automate file transfers, data management and program operation on remote PCs or LANs. Designed to operate with the CO/Session family, it's a perfect product for unattended communications any time, day or night.

Products that provide superior performance with unsurpassed technical support. Triton's family of products... solving all your communication needs.



TRITON TECHNOLOGIES

200 Middlesex Turnpike
Iselin, New Jersey 08830-0233
908-855-9440/FAX: 908-855-9608

Proudly distributed by:

Australia - Powertech	613 348 15
Germany - COMPLUS	0228 / 6480
Germany - Online Store	6074 / 8104
Netherlands - Unit 4	78-230899
Sweden - AU-System	8726 75 00
UK - Nett Ltd	0932 85021

Co/Session, Session/XL and Intelligent Graphics are trademarks of Triton Technologies, Inc. Other products are trademarks of their respective companies.

When it came to
Dunkin' Donuts'
Field System,
MIS Director
Dave Bennett
went
CODE - FREE.

**SAY
NO TO
CODE!**

SEE US AT
COMDEX/Fall '92
SANDS EXPO CENTER
BOOTH 3242

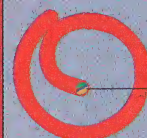
Dave joined the ranks of MIS professionals who have kicked code and boosted their productivity with Magic. A quantum leap beyond 4GL, Magic lets you develop applications by logically describing their functionality in a table-driven prototyping environment. This unique code-free, object-oriented methodology slashes your development and maintenance time by up to 90%!

Say YES to Magic Productivity



3GL, 4GL:
Design
Code/Compile/Link
Debug
Re-Code

Programming Cycle Comparison



Magic
Fast, Incremental
Development:
Design, Prototype,
Test and Modify
All-in-one

But don't let its programming speed fool you. Magic delivers superior programming power - excelling in the building of sophisticated database applications with advanced multi-user, multi-line and multi-window functionality. Transparent portability between all Magic-supported platforms, interoperability and client/server architecture make Magic the ideal strategic tool for open environment computing*.

To find out how you can join over 100,000 code-free Magic users, contact any of the numbers listed below. Your productivity depends on it.

* DOS, LANs, UNIX, VAX/VMS, OS/2, and CTOS/BTOS are all supported along with MS - Windows deployment.

Dunkin' Donuts is a registered trademark.

MAGIC
Magic Software Enterprises
PRODUCTIVITY BEYOND 4GL

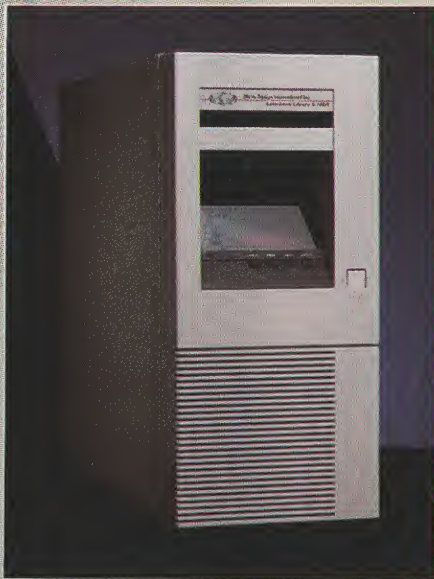
MSE - U.S. Tel: (714) 250-1718, Fax: (714) 250-7404 • MSE - U.K. Tel: (44-81) 902-8998, Fax: (44-81) 903-1465 • MSE - International H.Q. Tel: (972-3) 751-1914, Fax: (972-3) 751-1901

Australia	Austria	France	Germany	Hungary	Netherlands	Spain	Switzerland
Tel: (3) 412-3593,	Tel: (222) 535-9860,	Tel: (1) 4204-2118,	Tel: (06131) 995000,	Tel: (1) 165-3325,	Tel: (10) 434-3262,	Tel: (1) 442-1244,	Tel: (22) 731-1188,
Fax: (3) 416-2985	Fax: (222) 535-9861	Fax: (1) 4772-9183	Fax: (06131) 995024	Fax: (1) 165-3325	Fax: (10) 460-0805	Fax: (1) 441-6856	Fax: (22) 738-1190

Circle 405 on Inquiry Card.

NOVEMBER 1992 • BYTE 176IS-3

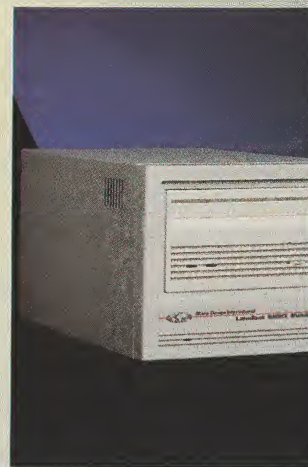
Why SETTLE for OPTICAL SPEED OR OPTICAL CAPACITY, When you can have BOTH!



The LaserBank Library 5-16DX multifunction optical jukebox is the fastest desktop jukebox available.

The new LaserBank Library 5-16DX optical jukebox contains the LaserBank 600MX drive, combining the fastest seek time (27ms average) with 10 GB of optical storage, and is available for AIX, DOS, Novell NetWare 386, and OS/2.

The MicroDesign LaserBank 600MX multifunction drive is available as a standalone internal or external drive, and is incorporated within the LaserBank Library 5-16DX.



CONTACT THE DISTRIBUTOR NEAR YOU

BENELUX: RME (31) 36 5334636
UK, EIRE: Ideal Hardware (44) 81 390 1211
GERMANY, SWITZERLAND, AUSTRIA: T.I.M. (49) 611 27090
FRANCE: Opus Technologies (33) 1 46054079
AUSTRALIA: SCSI CORPORATION (61) 2 550 4833

Spain: PROCO (34) 1 4165700
Portugal: ESDI (35) 11 7979491
Italy: GIGATEK (39) 45100370
GREECE: INTELECT (30) 1 647 4481
S. Africa: STARLAN (27) 11 804 4701



Micro Design International Inc.

Circle 408 on Inquiry Card.

INSIDE SIGNAL COMPUTING

Unlike general-purpose processors,
DSPs are designed to perform a limited number of functions quickly

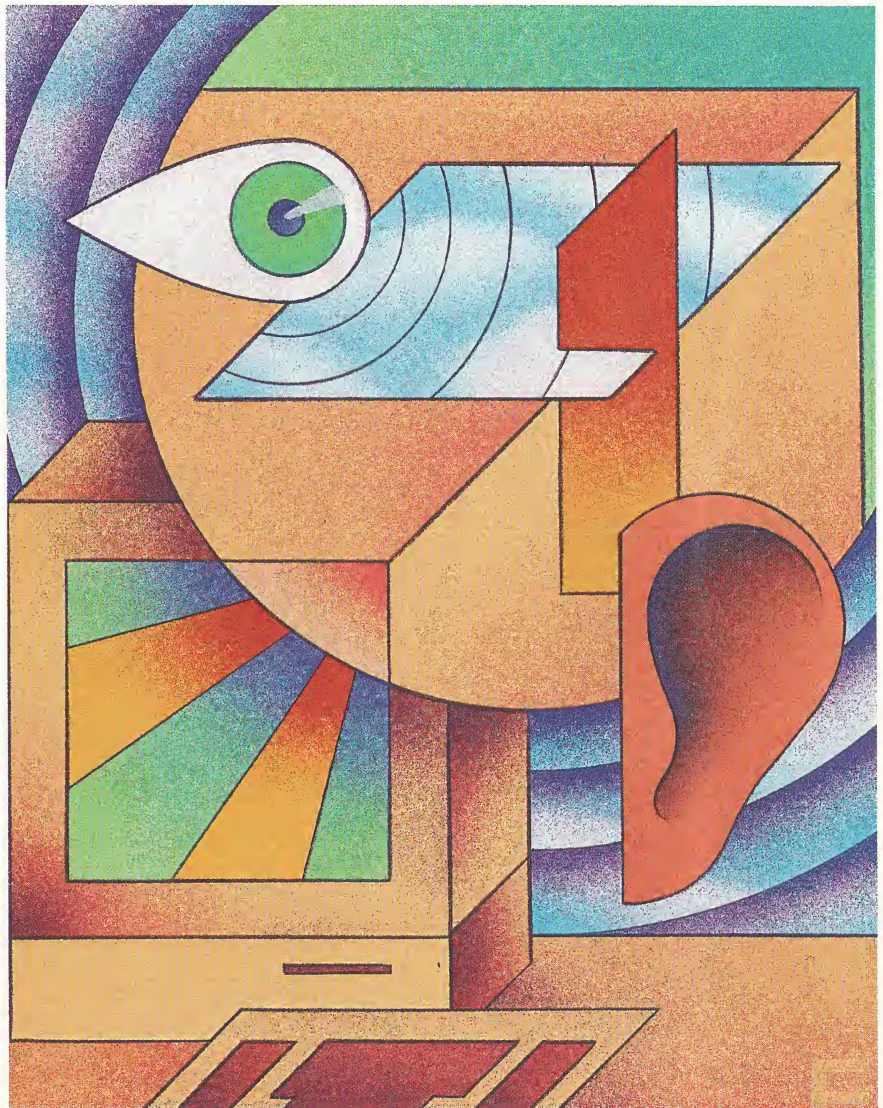
PETER WAYNER

Many cutting-edge desktop computer applications require the processing of real-world information, such as video and speech. Even though general-purpose CPUs can perform this processing, it is decidedly not their forte. The best way to turn an ordinary computer into a multimedia master is to add a digital signal-processing chip. These chips provide the ability to create and modify complicated video and audio signals in real time. That's why every Next machine is sold with a DSP (digital signal processor) on board, why IBM and AT&T are centering their multimedia offerings on DSPs, and why future Macs will come equipped with them.

What do DSPs do that is unique? Nothing, actually. Standard chips such as the 486 can do everything that a DSP does—just not as fast. Conversely, a DSP can do most things that a standard microprocessor can, but in most instances, a DSP would be much slower than a general-purpose CPU. Occasionally, it would even be incapable of handling certain problems.

The secret of the DSP's success is the modification of standard microprocessor architectures, which greatly enhances the chip's ability to compute the operations common in digital signature processing. The canonical signal processing function is the weighted sum. This is usually called a *digital filter*, or a *vector dot product*. One simple application of this function is noise reduction via smoothing by averaging the last *i* values of the signal. Most signal-processing functions are more complex, but by providing an architecture geared to handling this class of problems, DSPs easily outshine general-purpose CPUs.

continued



Architectural Highlights

DSPs contain special addressing features and beefed-up data buses that allow them to keep up with the flow of data and compute signal-processing functions quickly. Many general-purpose DSPs are on the market, and each of them has a different approach to finding the fastest way of moving bits in and out. The differences between a standard microprocessor and a DSP are usually found in four categories: instruction sets, addressing modes, interrupt structures, and structural changes.

Many of the examples in this article are taken from the architecture of the Motorola 56000 and Analog Devices' line of signal processors, but DSPs made by companies such as Weitek or Texas Instruments share many of the same features. This article concentrates on the architectural themes shared by most DSPs.

Instruction Flux

The easiest way to get a processor to compute weighted sums quickly is to add one instruction that computes $v1 * v2 + v3 \rightarrow v4$ quickly. $v3$ and $v4$ are usually the same register or a memory location called the *accumulator*, and it holds the partial total

DSPs use small looping programs that process large streams of data.

of the weighted sum as it's calculated term by term. $v1$ and $v2$ hold the weight and the value of the function. A digital filter can be computed by stringing together a number of these operations.

Adding this instruction to a processor forces you to make changes to standard processor architectures. Most DSPs devote a large section of silicon to a multiplication unit that can multiply $v1$ by $v2$ in one instruction cycle. This unit is often pipelined to save silicon space. In contrast, early versions of the Sun SPARC processors did not have a multiplication instruc-

tion. The compiler would simulate the multiplication out of shifts and additions. This points out a major difference between DSPs and CPUs: General machines spend more time moving information and bits around than they do multiplying them; DSPs spend their lives doing multiplication, so it pays to devote a lot of silicon to this feature.

The basic $v1 * v2 + v3 \rightarrow v4$ instruction takes three values from a register file and sends one back. A general DSP could execute the instruction when $v1$, $v2$, $v3$, and $v4$ are different registers, or memory locations. This would make it easier for the compiler to reduce complex arithmetical expressions to machine code. RISC architectures often place no restrictions on the use of registers for just this purpose.

The architectural cost of this approach, though, is often too high, even in the age of 3-million-transistor chips. You would need three data buses on the chip and extra circuitry to handle all the general cases that might come up. In almost all cases, however, the generality wouldn't be used by a DSP processing filter, which usually includes instructions where $v3$ and $v4$ are the same register. For that reason, many

You Can Look



9065s



T560i



T660i

And you'll want to take a look at NANA's newest monitors. All day. Every day. Because these NANA monitors deliver the highest flicker-free resolution in their class and conform to the strict new Swedish MPR II

requirements. Some even meet the TCO guidelines, the world's toughest VLF and ELF emission standards. You'll also find that each monitor has NANA's *intelligent* front control panel.

Designed for computer graphics professionals, the award-winning FLEXSCAN T-Series features Trinitron CRTs, providing the sharpest contrast and brightest images in the industry. Low distortion and a wider display

1991 BYTE AWARD OF DISTINCTION applies to T560i monitor.

DSPs include a special accumulator register and can process only functions of the form $v1*v2+ACC \rightarrow ACC$ (where *ACC* is the accumulator register). This accumulator is usually twice as big as a regular register to avoid rounding off the results of the multiplication after each step.

Another important addition to the instruction set of a DSP is the *loop counter*. A general microprocessor must be ready to execute *While* loops, where a block of code is executed until a specific test is satisfied. Loops that execute a set number of times are only a fraction of the loops in general code for RISC or CISC CPUs. Filter functions, however, almost always use a set number of passes through the loop. In many cases, there is only one multiply-and-accumulate instruction in the middle of the loop. The extra test-and-branch instruction executed at the end of each pass through the loop takes considerable time, and the time spent on this can nearly double the execution time of the loop.

The solution is to add a special counter that can be set at the beginning of the loop. At each pass through the instructions in the body of the loop, the counter is decremented and compared to zero in parallel.

This allows the loop to execute as fast as the instructions in the body of it because the increment, test, and branch instructions are handled at the same time the main body is executing. The extra circuitry involved in this loop counter is extensive, but it's worthwhile because DSP applications are heavily devoted to tight loops of predetermined length.

Some DSPs, like those from Analog Devices, include special barrel shifters that speed computations of functions (e.g., the fast Fourier transform). These allow the programmer to quickly shift a word of data over several bits.

The DSP difference

- single-instruction multiply-accumulate
- multiple data buses
- programmer-accessible caches
- specialized interrupt schemes
- loop-optimized addressing

Address Change

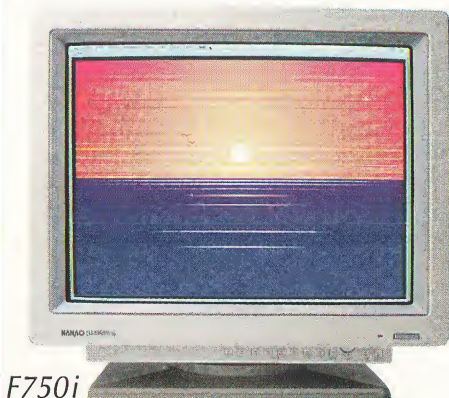
The architects who design DSPs also look at the pattern of memory references to determine the quickest way to increase the throughput of data. The standard addressing mode of a RISC microprocessor is to load a value from a direct address. Older CISC architectures (e.g., the 80x86 and the 680x0) also include indirect addressing modes, where a pointer is followed and occasionally incremented. These modes are usually supported by a DSP.

However, DSP designers also included stranger addressing modes that are immediately useful for implementing filter functions on the DSP. In most cases, a DSP takes a signal at time *t* and computes a filter function over the previous *i-1* values. The best way to store these *i* values is as a block of *i* words of memory. At time *t*, the signal value is stored in word $t \text{ MOD } i$ ($t \text{ MOD } i$ is what is left over after dividing *t* by *i*).

Many DSPs include a modular addressing mode that will look up a value at a location and an offset; increment the offset; and if the new offset is greater than the size of the buffer, reset the offset to zero. It can do all this in one instruction cycle.

continued

At Us All Day.



area make the *flat-square* FLEXSCAN **F-Series** the ideal monitors for those seeking an ideal Graphical User Interface and Desktop Publishing environment. For uncompromising quality at an affordable price, the FLEXSCAN

S-Series is your choice. And every NANAO monitor comes with a relentless attention to detail.

Whether you work in front of a 14" or 21" monitor, for two hours or twelve, you'll appreciate the

performance and ergonomics of NANAO monitors.

Take a look at your nearest NANAO dealer today, or for more information call NANAO.



NANAO

1-800-800-5202

1-310-325-5202 (CA)

Fax: 1-310-530-1679

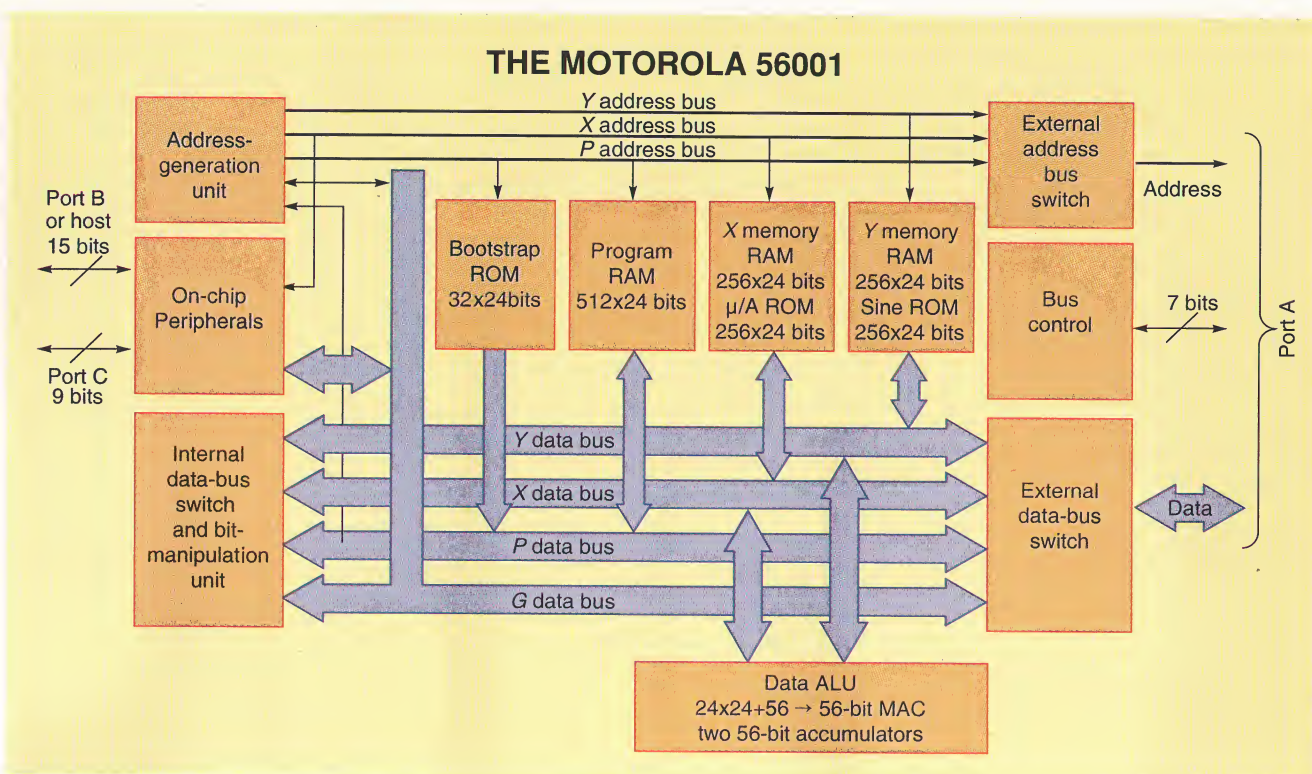


Figure 1: The main feature of the 56001 is the two 24-bit data buses (i.e., XDB and YDB) that feed into the ALU. The ALU can multiply the values on these buses and add the result to the 56-bit accumulator in one operation, speeding up many signal-processing operations. The 56001 also features large on-chip instruction and data caches. The separate address-generation unit saves the ALU from having to calculate the address of the next data item.

This work is handled by a separate ALU for computing the addresses. RISC systems, in contrast, have only one addressing mode to remove the need for the extra ALU, and processing a circular buffer takes many extra cycles. Here is the string of instructions that would handle this for a RISC processor:

```
t <- t+1; increment time
r1 <- t mod i
r2 <- base+r1; add offset to base
store value in r2; store it away
```

Another popular but seemingly strange addressing mode of DSPs is to reverse the bits. For example, an address such as 18 (1010 in binary numerals) is interpreted as 5 (0101 in binary numerals)—in a chip, the addresses take up the full word: 32 bits. This simple flip makes programming fast Fourier series expansions quicker—often as much as 10 times faster than on a similar RISC chip with the same cycle time and MIPS rating. It should be easy to see why when you imagine trying to reverse the bits in a word using standard RISC operations.

Double-Decker Buses

Getting information on and off the chip is a problem for any microprocessor designer, but DSP architects have made changes to standard processor design that have tuned these chips for high-speed data transfer. The most obvious change is splitting the processor/memory interface into an instruction stream and a data stream. This is an easy modification to make because DSPs often use small looping programs that process large streams of data. This allows the programmer and the processor to optimize the use of both of these paths.

Many DSPs from Motorola, Analog Devices, and other companies take this one step further. They have two data buses that grab data from the main memory simultaneously (see figure 1), which lets the chip read the two operands to be multiplied in the weighted sum in one step. This significantly increases the speed of the DSP because it reduces the bottleneck between memory and the processor.

DSPs don't go the next logical step (i.e., adding a third bus to write the data) because most filter functions take many inputs for each output. Not as much information flows in the other direction.

A traditional microprocessor (see fig-

ure 2) has a cache that lies between the chip and the main memory. This cache keeps a copy of the last *n* memory items that were referenced by the processor. Thus, it's able to supply these items to the processor faster than the main memory system can.

Caches work on the principle that much of the data that is touched by the processor is often reread a short time afterward. DSPs, on the other hand, have different access patterns. Most data comes into the chip once, and the result computed from the data leaves immediately afterward. When the data is reused, it's often done in a predictable way that can be exploited by the programmer.

Smoothing filters that use circular arrays, for instance, look only at the last *i* values of the function. Caches could keep track of these values, but it's better to leave this functionality off the chip because the circuitry required to determine the oldest values in the cache takes up silicon and adds a delay to the data bus.

This is worth the trouble in a general chip, where the complex data-access patterns would not be easily anticipated by the programmer. With DSPs, however, speed is so important that the optimization

Parallel



ability.

Anywhere, anytime, plug an SDI external data storage solution into the parallel port of your IBM PC-compatible or portable – without an interface card or adapter.

SDI's **Parallel Port Peripherals™** multiply the power of your laptop or notebook computer and add full-featured memory and backup capability to any PC system without the hassles of internal devices.

Whether your need is for a fast, high-capacity hard drive for day-to-day use, removable media for data transfer, the latest in CD-ROM technology or for system backup, SDI has a Parallel Port Peripheral in a size and capacity for you.

SDI storage units provide pass-through printing capability – and you can

daisy-chain up to seven SCSI devices, making total system integration easy.

Already in use in Europe, SDI subsystems are completely self-contained, including a 110/220 auto-sensing power supply, optional battery compartment and fan. Software drivers are available for DOS, Windows and OS/2 – and they're backed by a full one-year warranty.

Enjoy the economy and portability of flexible storage subsystems that can be shared between computers. Plug into SDI today. Call toll-free: (800) 872-7341.

Tape Backup



6800 Orangethorpe Ave.

Buena Park, CA 90620, U.S.A.

Tel.: (714) 562-5500 • Fax: (714) 562-5505



*Removable
Cartridge*

*CD-ROM
Optical Disk*

Hard Disk

*Read & Write
M.O. Disk*

BLOCK DIAGRAM OF THE 486

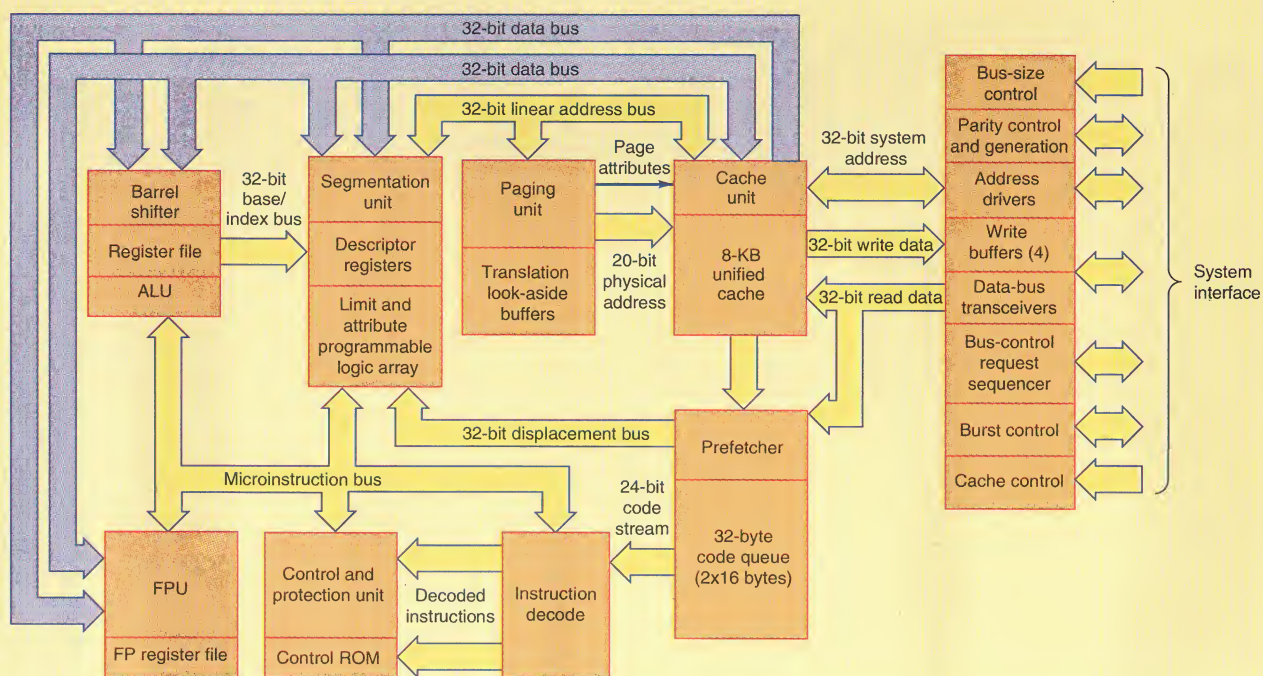


Figure 2: Like other general-purpose processors, the 486 is optimized to keep irregular blocks of data moving on and off the chip. The cache keeps copies of the most recently accessed data, but there is no facility for the programmer to designate what information is to be kept on-chip. The ALU is split into FPUs and integer units because the chip must handle both types of arithmetic, but the ALU doesn't have an accumulator or a fast multiplier to speed up multiplication and accumulate functions.

of performance in tight loops and other areas that normally fall to a cache is handled by the programmer.

DSPs often provide a small amount of local memory. For example, the Motorola 96000 has two banks of 512 32-bit words—one for each incoming data bus. The programmer can access each of these banks directly and arrange the access pattern of the program to keep the necessary data on the chip. Someone calculating a smoothing function of the last i values would keep the circular buffer in this memory space. A program that did not reuse the data, though, wouldn't use this special cache.

The instruction stream is handled in much the same way for similar reasons. The chips often provide a small amount of on-chip memory to hold small loops, and it would be possible to include the cache hardware to do this automatically. But that takes circuitry, and a cache cannot do the job as well as a programmer.

Here's one obvious case. Imagine that a program spends most of its time in a small loop that adds reverb to a guitar signal. After every million times through the loop, the programmer/composer slightly tweaks the weights used in the filter functions.

When it goes to do this tweaking, a cache would dutifully load the recalibration code on top of the loop. This would slow the system down when it returned to the loop. A programmer, however, would be able to properly allocate the small on-chip instruction memory to avoid this delay. In most cases, programs that run on DSPs have a simple enough structure that programmers can easily predict the pattern of instructions and subroutines.

Making Connections

Many DSPs also include several ports for communicating with other chips. Both Analog Devices and Motorola's DSP chips have two serial ports for exchanging data with modem chips, A/D converters, and other DSPs. These two lines allow the DSP to maintain its own connection with the outside world without bothering the main CPU. It can get a signal from a modem and interpret it, notifying the main CPU only when the data is ready for consumption.

In the most high-end signal-processing implementations, several DSPs are linked in a long chain. These arrangements can do many different calculations, including complicated matrix operations. But in most

cases, each DSP is responsible for its own filter function, and the result of one DSP is fed into another.

Floating-Point vs. Fixed-Point

General-purpose CPUs usually handle two types of numbers: integers and floating-point values. In many cases, however, they don't explicitly support floating-point calculations in hardware, because most tasks don't require them. You may need a special floating-point chip (e.g., a 387 or a 68882) to handle floating-point values.

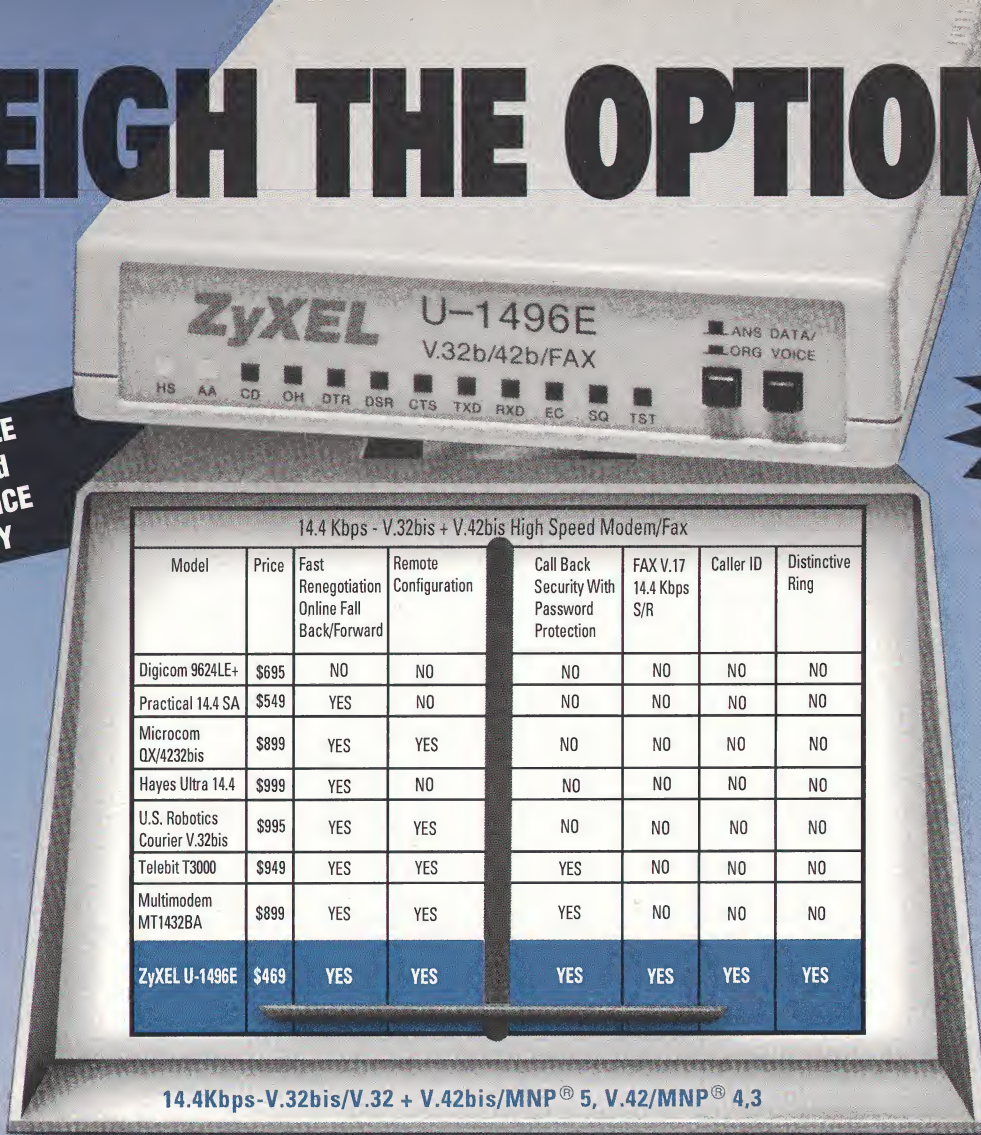
For the same reason, DSPs often come in two flavors: fixed-point and floating-point. Fixed-point DSPs are a cross between integers and real numbers that provides only a fixed level of precision.

An example of such a fixed-point system is the U.S. monetary system. Dollars can be broken down into numbers that have only two decimal points of precision. The complexity of the mathematics is closer to integer arithmetic than floating-point arithmetic, because the fractions can be easily converted into integers. For instance, you can do integer arithmetic on U.S. currency by converting everything into cents.

Floating-point chips must be able to

WEIGH THE OPTIONS

**NOW AVAILABLE
16.8Kbps and
DIGITIZED VOICE
CAPABILITY**



**ONLY!
\$469**
Also Available:
PC Plug-In Card
U-1496 B \$449

14.4 Kbps - V.32bis + V.42bis High Speed Modem/Fax							
Model	Price	Fast Renegotiation Online Fall Back/Forward	Remote Configuration	Call Back Security With Password Protection	FAX V.17 14.4 Kbps S/R	Caller ID	Distinctive Ring
Digicom 9624LE+	\$695	NO	NO	NO	NO	NO	NO
Practical 14.4 SA	\$549	YES	NO	NO	NO	NO	NO
Microcom QX/4232bis	\$899	YES	YES	NO	NO	NO	NO
Hayes Ultra 14.4	\$999	YES	NO	NO	NO	NO	NO
U.S. Robotics Courier V.32bis	\$995	YES	YES	NO	NO	NO	NO
Telebit T3000	\$949	YES	YES	YES	NO	NO	NO
Multimodem MT1432BA	\$899	YES	YES	YES	NO	NO	NO
ZyXEL U-1496E	\$469	YES	YES	YES	YES	YES	YES

14.4Kbps-V.32bis/V.32 + V.42bis/MNP® 5, V.42/MNP® 4,3

**The features you want in a High Speed-14.4Kbps Modem/Fax.
At nearly half the Price!**

ZyXEL's U-1496E offers all the standard features available in a 14.4Kbps- V.32bis+V.42bis modem/fax with DTE speeds up to 57.6Kbps. But you'll also find features you'd expect in only the "top-of-the-line" modems. So why pay more for the features you want, when you can get the best value from ZyXEL for less?

Caller ID/Distinctive Ring

Displays the caller's phone number, time and date stamp directly on your screen, and responds to the distinctive rings for incoming fax or modem calls.

Enhanced FAX

14.4Kbps G3 fax with automatic detection of fax or modem calls. Automatically receives, stores and/or prints faxes with our FREE ZFAX software.

Automatic Fast Rate Renegotiation

Online automatic speed fall-back/fall-forward allows the highest throughput achievable during poor line conditions.

Multi-Level Security

Security password protection and automatic call-back features are designed so only authorized callers can access your system.

Nonvolatile Memory Storage

Store up to 4 user configuration profiles in NVRAM, plus up to 10 user phone numbers and their associated passwords.

Software/System Compatible

Supports V.25bis autodial and enhanced AT Command Set, ensuring compatibility with popular communications/fax software. Available with MAC™, Windows™ and DOS fax software packages.

Guarantees

We offer a Full 5 year Parts and Labor Warranty, a 30 day money back guarantee and full BBS technical support line.

Once you've weighed the options, you'll agree: ZyXel's U-1496E offers the best value for less than any other modem/fax in its class. So, don't hesitate. **Call Today.**

ZyXEL USA
(800) 255-4101
Reseller discounts available

TEL (714) 693-0808

FAX (714) 693-0705

BBS/Tech.Support

(714) 693-0762

Visit us at COMDEX FALL '92 - North Hall #4644

ZyXEL USA, 4920 E. LaPalma Ave., Anaheim, CA 92807

All brand names and trademarks are the property of their respective owners.
Comparison chart was completed in May, 1992.

Circle 228 on Inquiry Card (RESELLERS: 240)



Editor's Choice: ZyXEL U-1496E
German Edition, 4/92

handle wide ranges of numbers, though. They must be able to multiply 1×10^{23} with 2.2×10^{-10} and find the right value. This requires large shifters that can shift the bits of the two numbers until they align correctly for the operation. This takes space and adds plenty of complexity.

Why have fixed-point chips? Most DSP operations involve plenty of fractions, and the fixed-point representation makes life easier for the programmer who would rather not convert everything to integers. In fact, overflows and underflows are the only big differences a programmer will find between fixed-point and floating-point DSPs. The programmer must watch for numbers that get too big or too small and trap for them.

Interrupts

One of the most important jobs of a DSP is processing data in real time. It must be able to handle information from an instrument like a seismometer while the ground is still shaking.

Standard CPUs come with an interrupt structure, which allows other hardware to get the CPU's attention. These general systems are designed to be used in many ways. When the interrupt is called, the state of the

system is saved, and the process jumps to a new location determined by the operating system. When the work is done, the interrupt system restores the old state and gets back to work. This is simple, and it handles all possible cases that come its way.

The DSP, however, must handle incoming data without slowing down the process. That's why most DSPs come with a special interrupt mode that inserts a small number of instructions into the standard instruction stream. For example, the Motorola 56000 allows the programmer to define two general instructions as the interrupt. When the signal arrives, the two instructions are placed at the top of the pipeline, and the standard instruction stream is held up for two instructions. Usually, these instructions are enough to grab a value from one of the serial ports and store it in memory. This type of interrupt can be dangerous, because the two instructions can do anything to the state of the machine. When it's used correctly, though, it keeps the data coming in as fast as possible.

A Workhorse for the 1990s

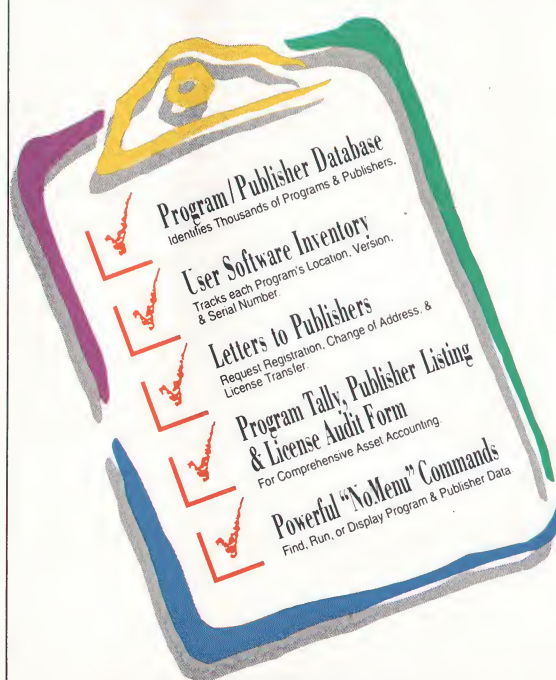
DSPs are becoming popular for attacking problems that involve heavy number crunch-

ing. The architecture is tuned to get data onto the chip, do multiplication and accumulate instructions, and get the data off-chip as fast as possible. The modifications in the standard processors' instruction set, data buses, and interrupt structure are simple and general enough to be useful in a number of nonsignal applications (e.g., matrix multiplication or neural networks).

In one sense, DSPs are the last thriving remnants of CISC architectures. The chips include many special-instruction formats that are useful for frequently occurring instructions. These features are difficult for a compiler to use efficiently in all cases, but this is not a limitation because DSPs spend most of their time in small loops that programmers can hand-tune in assembly code.

An ordinary computer can be converted into a multimedia master by adding a digital signal-processing chip. The popularity of multimedia applications could make DSPs as popular in the 1990s as math co-processors were in the 1980s. ■

Peter Wayner is a consulting editor for BYTE. You can contact him on BIX as "pwayner."



CHECKLIST
SOFTWARE MANAGEMENT & REGISTRATION TRACKING SYSTEM

Your Software. What's It Worth to You?

Over time, you may spend more on software than you do on hardware. Keeping track of your programs, compatibility, new versions, and serial numbers can become a time-consuming task. But if you don't, you may lose your eligibility for upgrades, technical support, and other benefits.

Check✓List, the new Software Management And Registration Tracking system is the SMART way to protect your valuable investment in software. Check✓List works automatically to identify the programs installed on any disk drive, remember their location, and even write letters to the publishers updating the registration data.

- Searches any Disk Drive to Create Inventory Database
- Identifies Over 5,000 Program Titles and Publishers Automatically
- Includes Publisher's Addresses and Phone Numbers
- Finds "Unknown" Programs
- Determines Exact Program Version
- Users can Add, Delete, or Edit Programs and Publishers

- Stores Serial Numbers
- Exports Inventory Data to Other Programs
- Five Standard Report Types and Three Letters
- FREE Update of Master Library Included with Registration

Once you start using Check✓List, you will never waste time searching for a "lost" program, wondering what revision you're using, or finding technical support numbers. As an added bonus, the "NoMenu" command makes it easy for DOS users to automatically access any program without knowing the directory!

So get the SMART approach to software licensing and save time, money and hassles on software updates, upgrades, and volume purchases.



TouchStone
Software Corporation
2130 Main Street, Suite 250
Huntington Beach, CA 92648

(800) 531-0450 or (714) 969-7746

Copyright ©1992 TouchStone Software. ALL RIGHTS RESERVED. CheckList is a trademark of TouchStone Software Corp. Huntington Beach, CA

THE COLOR OF POWER



COLOR NOTEBOOK DCN386SL

CPU

Equipped with the speedy 25MHz/80386SL, the latest Intel processor designed especially for notebook computers. Lots of built-in power saving features.

BATTERY

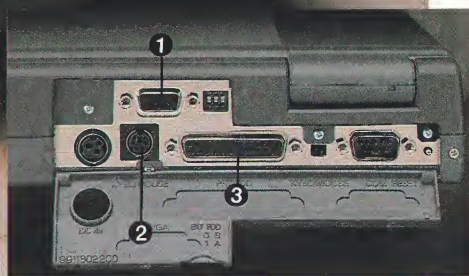
Long-life, 2.8 AH Ni-Cad minimal weight battery provides 3-4 hours of power with normal use. Easy to change, quick to recharge.

KEYBOARD

Popular ergonomic design, available in European versions.

BUILT-IN J-KEY MOUSE

Embedded in the keyboard, the J-key mouse is a clever alternative for an external tracker ball or mouse for maximum portability.



1- External PS/2 compatible keyboard & mouse connector.

2- External VGA color monitor connector (800 x 600).

3- Bi-directional enhanced parallel port/external FDD connector.

With locations in France and The Netherlands,
Daewoo Telecom Europe serves the European
market with an extensive line of notebooks, desktop
and monitor products.

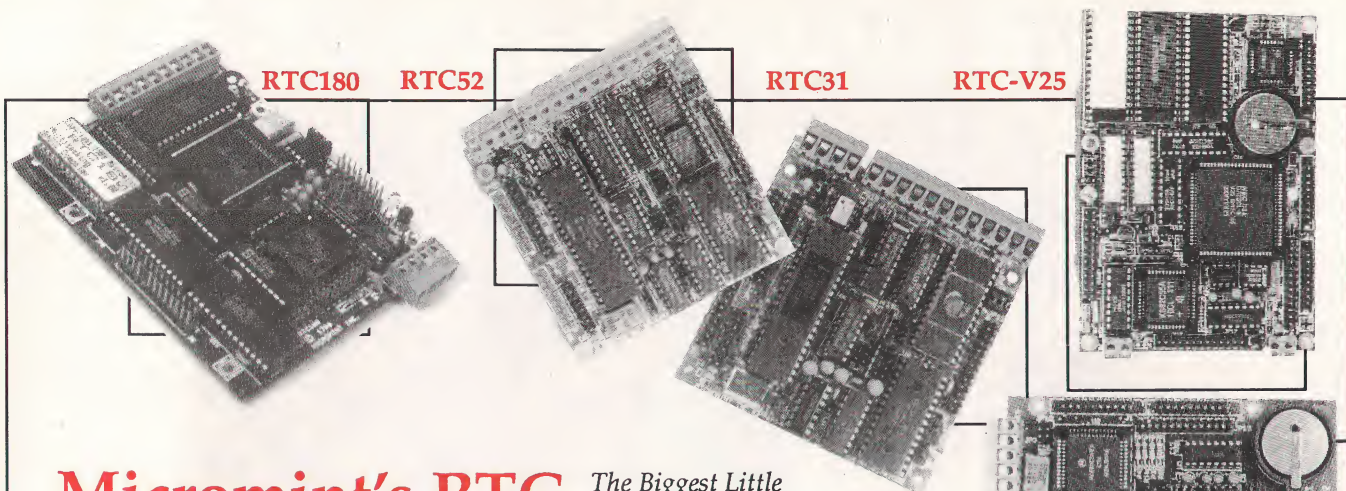
DAEWOO

Your Powerful Partner

DAEWOO
TELECOM EUROPE
France
Tel: + 33-1-48631563
Fax: + 33-1-48630046

DAEWOO
TELECOM EUROPE
The Netherlands
Tel: + 31-2503-36530
Fax: + 31-2503-37214

Circle 428 on Inquiry Card.



Micromint's RTC *The Biggest Little Controller Family in the World!*

Micromint's RTC series of compact controllers gives you the BIGGEST list of usable features available in LITTLE controller packages.

RTC controllers and peripherals let you match the processor to the job: 8031, 80C52BASIC, HD64180, 68HC11, or V25. Next, you add the optional I/O you need: serial (RS-232 or RS-485), parallel, A/D, D/A, optoisolated, high-voltage, IR, and more!

With the RTC Stacking Bus, all this power comes with a footprint ranging from 3.5" x 3.5" to 3.5" x 5" (depending on the processor board required). No other controller series gives you the BIG power of RTC controllers in the same LITTLE space.

RTC-HC11



Dexdyne, Ltd. 15 Market Place, Cirencester, Glos. GL7 2PB, UK
Tel: 0285-658122 • Fax: 0285-655644

This is what BYTE (8/1991)
says about
CLASSNET

NEWS WHAT'S NEW INTERNATIONAL

"Computerized Classroom

Classnet from Minicom Advanced Systems is a dedicated communication network that gives instructors control over all activities, by all students, in the classroom.

...The Electronic Blackboard function lets you see a student's screen, display your own screen to any or all students, display a student's screen to the entire class, and send messages in real time to any or all students. The Interject function lets you disconnect the keyboard and darken the students' screens, giving you command over classroom activities.

By simulating the teacher's keyboard on a student's keyboard, the

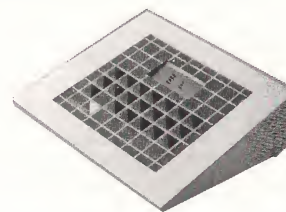
Assist function lets you help a student working in real time without losing visual contact with the entire class.

The Communication function lets you prepare a lesson by transmitting work files to students; send data, text, or even an exam to all students; collect students' files at the end of a lesson or exam; and connect students to external devices such as videodisk players and modems.

The Print function lets you control one printer from the teacher's unit, while the Help function tells you that a student needs help, showing you the student's station number on your screen..."

CLASSNET - The unique communication network, giving instructors control over all activities, by all students in the classroom.

For only US\$999 for the Teacher's Control Unit and US\$245 for the Student's Unit.



Available for MAC
NEW- MULTIMEDIA SHARING

To find out the full facts about
CLASSNET contact us at:



Minicom
Advanced Systems Ltd.

3, Beit Hadfus St.,
Givat Shaul
Jerusalem 95483, Israel
Tel: 972-2-518593, Fax: 972-2-518971

Hardlock E-Y-E® - tying the hands of software pirates



The effective way to protect your software

FAST Electronic has made life a lot harder for software pirates. Hardlock E-Y-E was designed using cryptographic principles. It took the experience and know-how of Germany's number one in software protection and the leading edge technology of a US semiconductor company to create the ultimate software protection tool.

The technology programmers have at their fingertips

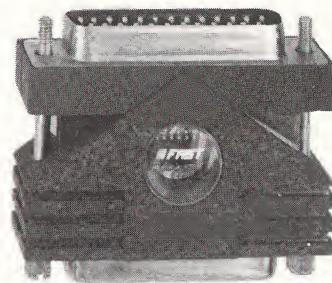
Hardlock E-Y-E is based on a custom chip and combines all the features that a programmer would expect from such a device: secure, algorithmic query routines and an optional non-volatile memory for custom configurations. With the Crypto-Programmer card from FAST you can program the algorithmic parameters and the memory within seconds. This unique card guarantees that no one else can burn Hardlock E-Y-Es with your codes. Linking Hardlock E-Y-E to your software is easy: you can either protect your .COM and .EXE files with the automatic encryption software HL-Crypt or integrate FAST's high level language routines into your source code.

Readily acceptable to your customers

Hardlock E-Y-E allows unlimited backup copies of the master floppy. The customer gets the device together with the software and plugs it into the parallel port between the printer and the PC. Daisy-chainability, outstanding reliability and the compact high tech design guarantee that your customers will accept Hardlock E-Y-E.

The benefits your management will appreciate

Hardlock E-Y-E can be programmed by the software house with the Crypto-Programmer card. This ensures optimum delivery schedules and stock flexibility. Revenues will go up as software piracy and multiple usage are prevented.



Hardlock E-Y-E
programmable, algorithmic response
and memory option - all in one

Order your evaluation package today!

Contact B. Ajari at FAST Electronic or one of the offices below :

UK:

Magnifeye
Tel: ++44-71-2218024
Fax: ++44-71-7923449

France:

FAST Electronica S.A.R.L.
Tel: ++33-1-48837811
Fax: ++33-1-48839734

Spain/Portugal:

FAST Iberica S.L.
Tel: ++34-1-3613222
Fax: ++34-1-3613219

Italy:

Techne S.R.L.
Tel: ++39-59-440690
Fax: ++39-59-440720

BeNeLux:

Crypsys Data Security
Tel: ++31-1830-24444
Fax: ++31-1830-22848

Greece:

FAST Hellas AE
Tel: ++30-1-6855 689
Fax: ++30-1-6472 304

USA/Far East:

Glenco Engineering Corp.
Tel: ++1-708-8080300
Fax: ++1-708-8080313

Hungary:

Szki Recognita Corp.
Tel: ++361-201-7973
Fax: ++361-201-7607

Yugoslavia:

G & G Electronic
Tel: ++38-41-211624
Fax: ++38-41-211604

FAST
Fast Electronic GmbH

FAST Electronic GmbH, Kaiser-Ludwig-Platz 5, D-8000 München 2, Germany, Tel: 49/89/539800-20, Fax: 49/89/539800-40

For those who appreciate the art



of Creating Computer Programs

You need a "special kind" of programming environment that lets you insert your most artistic thoughts into your application.

You want an "all-in-one" programming environment — with all the tools you need — for creating high-quality feature-rich applications.

You expect a "fast and powerful" programming environment that performs with instant results — so you can create a "masterpiece" that will endure the test of time.

You deserve the Clarion Professional Developer.

The Clarion Professional Developer redefines the way that you develop PC application programs.

It puts you in full control of your application — opening up new, creative potential for the programming artisan.

Professional Developer is a fully-equipped development environment. With 14 dynamic utilities and the rich, comprehensive Clarion language — it gives you all the tools you need to design, develop, debug, and deliver complete, expressive applications.

Professional Developer is fast — it lets you turn your ideas into applications in much less time. A fraction of the time than the old-fashioned way of programming.

And with Professional Developer, your applications stand the test of time. You can create new or modify existing applications, as quickly and frequently as your application needs change.

Never again will too little time or limited tools restrict you from creating the kind of applications you dream of. With Clarion Professional Developer this never happens...you're just a few seconds away from capturing the true art of application development.



1990
- FINALIST
PC Magazine Award
for Technical Excellence



DEVELOPMENT TOOLS
Clarion Professional Developer
Version 2.1
Clarion Software

CLARION SOFTWARE

150 East Sample Road
Pompano Beach, Florida
(305) 785-4555 • 1-800-354-5444

The Computer Industry in Asia:



The Four Dragons and Beyond

The Computer Industry in Asia: The Four Dragons and Beyond

In addition to the computer industries of the four dragons, Taiwan, South Korea, Hong Kong and Singapore, there is also burgeoning development in the computer industry Asia-wide. Much of this development is growing out of the rapid changes in response to the economic difficulties the global industry has been going through.

The world-wide recession, which is having a serious influence on the computer industry in the industrialized nations, is also affecting the industry in Asia. While most Asian economies have not been greatly affected by conditions in Europe and North America, this has not been the case in the computer industry. The combination of export dependence and changing economies at home is engendering rapid change in the structure of the regional industry.

Although right now there is no question that Japan is the dominant technological force and has the largest industry, or that the manufacturing muscle of the four dragons is the second most important factor in the Asian industry, forces from both within and without are creating pressure for rapid change in the region.

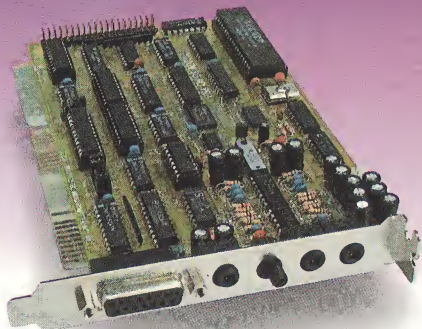
Economic circumstances in the Asian industry are leading to two main results. On the one hand, companies from the four dragons are seeking to exact every economy they can from their operations to maintain some distance between their cost of goods sold and the heavily depressed prices they can get from the North American market. On the other they are accelerating their push for European market share where profits remain for the moment comparatively high.

REDUCING COSTS—SPREADING THE INDUSTRY

The China Triangle

External pressures on Asian computer companies are forcing them to find ways to limit costs at home. This is leading to some swift and important changes.

The best example is the major shift underway in the Taiwan and Hong



GOLDEN SOUND CARD

**THE UNIQUE SOUND CARD IS
COMPATIBLE WITH 4 SOUND &
MULTIMEDIA PC STANDARD,
AND BUILT-IN STEREO SURROUND
EFFECT IN THE WORLD.**

MPU-401 (UART) MIDI, GS/MT-32 INSTRUMENTS,
SOUND BLASTER, MULTIMEDIA PC AND
ADLIB SOUND CARDS COMPATIBLE!

■ GOLDEN SOUND VER 2.5 & 3.0 MULTIMEDIA SOUND CARD

1. COMPATIBLE WITH ALL SOUND BLASTER'S SOFTWARE
2. COMPATIBLE WITH MPU-401 (UART MODE) & GS/MT-32 INSTRUMENTS

- BUILT-IN MIDI INTERFACE OF MPU-401 (UART MODE) & SOUND BLASTER MIDI COMPATIBLE
- BUNDLE SIMULATE SOFTWARE OF GS/MT-32 INSTRUMENTS
- SUPPORT ALL MIDI SOFTWARE OF MPU-401 (UART MODE) COMPATIBLE
- SUPPORT ALL SOUND GAME SOFTWARE OF GS/MT-32 INSTRUMENTS COMPATIBLE
- SUPPORT THE MICROSOFT WINDOWS 3.1 & MULTIMEDIA EXTENSIONS 1.0
- OPTIONAL MIDI CABLE

3. SAMPLING RATE

- INPUT : 1KHZ-20.8KHZ/8 BIT PCM
- OUTPUT : 1KHZ-48KHZ/8 BIT PCM
- TO SET COMPRESSION & DECOMPRESSION IN HARDWARE
- COMPRESSION RATE - 4:1, 3:1, 2:1

4. VOICE OUTPUT

- PHONE OUT : CONNECT WITH STEREO EAR PHONE OR NON-AMPLIFIER SPEAKER.
- LINE OUT : CONNECT WITH AUDIO POWER AMPLIFIER NON-SIGNAL NOISE & NON-DISTORTION.
- OUTPUT POWER AMPLIFIER: 4W

5. VOICE INPUT

- LINE IN : ALLOW TO BE DIRECTLY RECORD INTO COMPUTER FROM WALKMAN, CD-ROM DRIVE OR AUDIO MACHINE THROUGH RECORDING WIRE OR MICROPHONE JACK (WITH MONITOR FUNCTION WHILE YOU ARE RECORDING)

6. FM IC CHIPS

- YAMAHA 3812/3014 FM SYNTHESIZER IC CHIPS
- FULLY COMPATIBLE WITH ADLIB SOUND CARD
- 11 SOUND CHANNELS (6 MELODY CHANNELS & 5 PERCUSSION CHANNELS OR 9 MELODY CHANNELS)

7. MIXER EFFECTS

- BUILT-IN MIXER EFFECT CIRCUIT
- MIX FM, DIGITIZED VOICE, LINE-IN & CD-ROM

8. IRQ/DMA & I/O SELECTABLE

- IRQ - 2,5 OR 7 SELECTABLE
- DMA - 1 OR 3 SELECTABLE
- I/O - 220 OR 240 SELECTABLE

9. MULTI-FUNCTION ADAPTOR

- BUILT-IN MIDI OR GAME, LINE IN/OUT (L&R), PHONE OUT ADAPTOR AND VOLUME CONTROLLER
- BUILT-IN PC SPEAKER JUMPER

10. CD-ROM :

- BUILT-IN CD-ROM AUDIO SIGNAL CONNECTOR
- MIX WITH FM & VOICE
- CAN BE FOR BACKGROUND MUSIC
- CD-ROM INTERFACE CARD OPTIONAL (AT BUS OR SCSI)

11. GAME I/O PORT

- BUILT-IN STANDARD GAME I/O INTERFACE & ADAPTOR
- SUPPORT ALL IBM COMPATIBLE JOYSTICKS

■ THE EXTRA FUNCTION FOR VER.3.0

1. BUILT-IN AT-BUS WITH SONY CD-ROM INTERFACE AND SURROUND EFFECT CIRCUIT
2. VOICE INPUT WITH MIC-IN
3. BUNDLED WITH MULTIMEDIA DEVELOPER TOOL BOX & GS DEVELOPMENT LIBRARY

■ GOLDEN SOUND PRO II & PRO III MULTIMEDIA STEREO SURROUND CARD

1. COMPATIBLE WITH MULTIMEDIA PC SOFTWARE
2. FULLY COMPATIBLE WITH SOUND BLASTER'S SOFTWARE
3. SUPPORT MICROSOFT WINDOWS 3.1 & MULTIMEDIA EXTENSIONS 1.0

4. COMPATIBLE WITH MPU-401 (UART MODE) & GS/MT-32 INSTRUMENTS

- BUILT-IN MIDI INTERFACE OF MPU-401 (UART MODE) & SOUND BLASTER MIDI COMPATIBLE
- BUNDLE SIMULATE SOFTWARE OF GS/MT-32 INSTRUMENTS
- SUPPORT ALL MIDI SOFTWARE OF MPU-401 (UART MODE) COMPATIBLE
- SUPPORT ALL SOUND GAME SOFTWARE OF GS/MT-32 INSTRUMENTS COMPATIBLE

5. STEREO SURROUND EFFECT

- BUILT-IN YAMAHA 7128 SURROUND IC CHIP AND CIRCUIT
- STEREO SURROUND EFFECT

6. SAMPLING RATE

- INPUT : 1KHZ-24.0KHZ (STEREO)/8 BIT PCM (PRO II)
1KHZ-44.1KHZ (STEREO)/8 BIT PCM (PRO III)
- OUTPUT : 1KHZ-24.0KHZ (R&L STEREO)/8 BIT PCM (PRO II)
1KHZ-48.0KHZ (MONO)/8 BIT PCM (PRO II)
1KHZ-48.0KHZ (STEREO)/8 BIT PCM (PRO III)
- TO SET COMPRESSION & DECOMPRESSION IN HARDWARE
- COMPRESSION RATE - 4:1, 3:1 & 2:1

7. CD-ROM INTERFACE

- BUILT-IN AT BUS CD-ROM INTERFACE (DRIVE - MODEL: CR-521-B) OR (CR-522) (PRO II)
- BUILT-IN SCSI CD-ROM INTERFACE (PRO III)
- BUILT-IN CD-ROM AUDIO CONNECTOR/MIXER
- IT CAN BE FOR BACKGROUND MUSIC

8. VOICE OUTPUT

- LINE OUT : DIRECTLY OUTPUT TO AUDIO POWER AMPLIFIER, NON-SIGNAL NOISE & NON-DISTORTION.

9. VOICE INPUT

- MIC IN : IMPEDANCE 600 Ω , 3.5MM INPUT JACK
- LINE IN : ALLOW TO BE DIRECTLY RECORD INTO COMPUTER FROM WALKMAN, CD-ROM DRIVE OR AUDIO MACHINE (WITH MONITOR FUNCTION WHILE YOU ARE RECORDING)

10. FM IC CHIPS

- YAMAHA STEREO 262/512 FM SYNTHESIZER IC CHIPS
- FULLY COMPATIBLE WITH ADLIB SOUND CARD
- 22 SOUND CHANNELS

11. MIXER EFFECTS

- BUILT-IN MIXER EFFECT CIRCUIT
- MIX FM, DIGITIZED VOICE, CD-ROM, NATURE VOICE (MIC-IN) AND LINE-IN ... ETC.

12. IRQ/DMA & I/O SELECTABLE

- IRQ - 2,5 OR 7 SELECTABLE
- DMA - 1 OR 3 SELECTABLE
- I/O - 200 OR 240 SELECTABLE

13. MULTIMEDIA FUNCTION BOX (OPTIONAL)

- POWERFUL DESIGN & EASY FOR USING
- BUILT-IN MIDI IN/OUT, LINE IN/OUT (L&R), MIC IN/VR CONTROL & PHONE OUT ADAPTOR AND VOLUME CONTROLLER
- BUILT-IN 20W AMPLIFIER & HI-FI STEREO SPEAKER
- BUILT-IN HI-FI AM/FM RADIO

14. GAME I/O PORT

- BUILT-IN STANDARD GAME I/O INTERFACE & ADAPTOR
- SUPPORT ALL IBM COMPATIBLE JOYSTICKS



**TOPTEK MICRO
COMPUTER INC.**

Head Office & Factory:

TOPTEK Micro Computer Inc.
5F, No. 11, Lane 163, Shing-Yi Rd.,
Panchiao City, Taiwan, R.O.C.
TEL : 886-2-964-7096
FAX : 886-2-961-9586
BBS : 886-2-964-7081



COMDEX/Fall '92 November 16-20, 1992
Las Vegas, Nevada USA

See Us At #S1238

U.S. Office & Service Center:

TOPTEK Computer (U.S.A.) Inc.
2000 Wyatt Drive, Suite 2
Santa Clara, CA 95054, U.S.A.
TEL : (408) 748-1777
FAX : (408) 727-4586

SINGAPORE Office:

STE International (Singapore) Pte Ltd.
211 Henderson Road #03-03,
Singapore 0315
TEL : (65) 274-8448
FAX : (65) 273-7226

Kong industries. Where in the past Taiwan has always been able to rely on the domestic labor pool as a source of cheap and compliant labor, this situation is changing. As the standard of living has improved in the last few years at a pace reserved for only the healthiest or even overheated economies, the availability of cheap labor has shrunk almost as quickly.

Taiwanese computer manufacturers, while not as cheap labor-dependent as the footwear or textile industries, are nonetheless experiencing increasing difficulty in maintaining a work force that allows profitable operation. As this situation was developing, relations between the Nationalist government on Taiwan and the rulers of the communist mainland have been undergoing an accelerated improvement driven by their common economic interests. As the industrialized west and Japan earlier facilitated the economic "miracles" and industrialization of the four dragons in their own search for reduced labor costs, Taiwan, and to some degree the others, are now expanding regionally with the same objective.

For Taiwan, and Hong Kong, which will revert to mainland Chinese control in 1997 with supposed freedom from economic interference, the most obvious choice for expansion is south China, where the pace of economic development, fueled by Beijing's special economic policies for the region, is reaching an almost frenetic level. While the PRC government continues to give lip service to its socialist ideals, one can be forgiven for not realizing that China is still supposed to have the "communist" adjective grafted onto it.

To some degree it looks more as if south China will be absorbed into Hong Kong and Taiwan than vice versa. With the establishment of the Special Economic Zones, which are supposed to bring the economic benefits of a market economy to the China mainland while keeping out the "spiritual pollution" of western capitalist culture, the old men in Beijing hope to modernize China by piggy backing on the capitalist miracles to their south. Since three of the four dragons are for the most part Chinese, they think they see a way to leapfrog development into the 21st century.

Most recently, there have been rancorous mutterings from Beijing, always sensitive to accusations about its political and human rights record, to the effect that Singapore should be the model. They see Singapore as a paradigm for development because in their view, it epitomizes the result they would like to achieve, mainly, to divorce economic and technological development from social change.

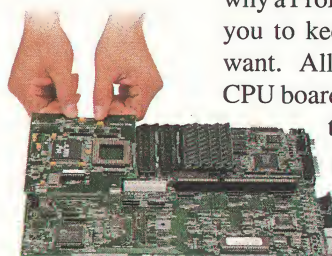
While this subject might seem a bit far afield in discussing shifts in the Asian computer industry it is actually of great significance, for only by divorcing politics from development has the PRC been able to create the conditions necessary to engender significant investment in the south China region. As computer technology is seen as being at the forefront of high technology development, and as one of the most desirable industries to attract, mainland authorities have been at pains to ensure that the SEZs are as appealing as possible to investors from Hong Kong and Taiwan.

The results would indicate that they have been more than a little successful. In spite of serious questions about the adjudication of any number of potential conflicts and problems that might arise, and in the case of Taiwan companies, active warnings from their government about exposure to excessive risk, there has been a virtual flood of investment by

Just What Makes A PC Professional?

Upgradable Design

In a cost-conscious world, you can no longer replace your computer every two years. That's why a Professional PC, like MITAC's, allows you to keep your computer as long as you want. All you have to do is replace the old CPU board with a new one. And MITAC has the entire range of CPU boards for you to choose from—Intel® 386DX™ to 486DX-33™. So, now, you can keep your PC as long as you want.



Enhanced Security Features

These days, buying any PC without security is asking for trouble—and especially a Professional PC. That's why, all of MITAC's PCs come with multi-layered security built-in—with password control for boot-up, keyboard lock, read and write control for floppy and hard drives, serial and parallel port access rights, as well as virus protection... in short, a complete security.



Microsoft® Windows™ Accelerator

With MITAC's Professional PCs, you get an on-board Windows Accelerator chip. It is not an option; it comes with your PC to speed up your Windows applications as many as seven or eight times.



MITAC has all what you need



People Committed To InfoTech



MITAC EUROPEAN DISTRIBUTION OFFICE Unit 12, Hortonwood 32 Telford, Shropshire TF1 4EU England TEL: 44-952-670370 FAX: 44-952-67688
MITAC (UK) LTD. Unit 1, Hortonwood 32 Telford Shropshire TF1 4EX, England TEL: 952-676676 FAX: 952-605605 ■ MITAC GmbH Technorama/
Benbaumer Weg 6, 4000 Düsseldorf 30 Germany TEL: 0211-41-2086, 7 FAX: 0211-41-2080 ■ AMERICAN MITAC CORP. 48571 Millmont Drive Fremont, CA
8 U.S.A. TEL: 510-6235300 FAX: 510-6235390 ■ MITAC JAPAN CORP. 5-7-14, Kita-Shinagawa, Shinagawa-Ku, Tokyo 141, Japan TEL: 03-5420-2822 FAX:
420-4586 ■ MITAC AUSTRALASIA PTY LTD. No. 353 Warrigal Rd., Cheltenham, VIC 3192, Australia TEL: 61-3-585-1055 FAX: 61-3-585-1596
MITAC PACIFIC (H.K.) LTD. Rm. 502, Shiu Lam Building, 23 Luard Rd., Wanchai, H.K. TEL: 852-528-6782 FAX: 852-861-3754 ■ MITAC
INTERNATIONAL CORP. 8th Fl., No. 75 Ming Sheng E. Rd., Sec. 3, Taipei, Taiwan, R.O.C. TEL: 886-2-501-8231 FAX: 886-2-501-4265

is a registered trademark and 386DX and 486DX-33 are trademarks of Intel Corporation. MITAC is a registered trademark of MITAC International Corporation. The "intel inside" logo is a trademark of Intel Corporation. Microsoft Windows is a registered trademark of Microsoft Corporation

Circle 451 on Inquiry Card (RESELLERS: 452).

Hong Kong and Taiwan computer firms, particularly in the Shenzhen Special Economic Zone just over the border from Hong Kong.

Shenzhen, which has been in operation for some years, is developing so rapidly that it is becoming an almost indistinguishable extension of Hong Kong. Low-end production that depends on cheap labor has already moved there in force. Some company executives in Taiwan have indicated that the only way to protect profit on some products such as sub-486 motherboards is to have the labor-intensive insertion work done on the China mainland.

The difference in wages is the most important factor in this trend, although there are a host of incentives being offered. As the Shenzhen experiment has proven itself to be almost wildly successful, the mainland authorities are moving rapidly to expand on the concept, opening more SEZs and drawing in further investment. Shanghai, whose metropolitan area population exceeds 15 million, is aggressively moving to reassert itself as the dominant economic center of the country and regain some of its pre-communist era glory.

Large investments in infrastructure, including major capital investments from abroad, will put Shanghai in a position to heavily influence development in all of south China reaching well up the Yangtze river into the heart of the country. The revamping of port facilities which will begin soon and be financed by one of Hong Kong's largest conglomerates, coupled with aggressive attraction of further investment in high-tech industries, will continue to have a profound influence on this triangular collaboration. The combination of better and larger infrastructure, a comparatively better educated and trained workforce, the large knowledge base of Hong Kong and Taiwan and the propensity for cultural cohesion among the Chinese are very likely to make this cooperation a force in the Asian computer industry second only to Japan.

Hong Kong's return to Chinese control in 1997 will bring the colony's substantial engineering resources under more direct influence from the policy makers in Beijing. For while non interference is a key part of the agreement between Beijing and London, in practice, Beijing is already applying steady pressure to influence policy and projects that concern it.

In spite of the ongoing brain drain among Hong Kong professionals caused by their fear of post-'97 conditions, some reversal of the outflow of talent is beginning. As young professionals who have succeeded in getting residence or citizenship elsewhere return to take advantage of the vigorous economy and high demand for their services, China is likely to inherit a substantial percentage of the Hong Kong industry's expertise. This will enable Beijing to continue to use this expertise to rapidly develop its own cadre of low-cost engineering talent. And it is this prospect which suggests again the substantial lead the China triangle will have over regional competitors in the next few years.

The hard-charging economies of Thailand and Malaysia may have the cheap labor appeal, but they cannot begin to compare with even the current extent of engineering resources China has, let alone its near-term potential. Up and coming economies in Viet Nam and the Philippines are even less likely to be able to compete on this score.



TAIPEI

COMPUTEX '93 International Computer Show June 1-5, 1993



Computers • Peripherals • Software • Office automation systems • Software

Data communications • Applications • Mass storage • Components

The biggest, most important computer show in Asia. Your point of access to thousands of opportunities!

Organizers:



CHINA EXTERNAL TRADE
DEVELOPMENT COUNCIL



TAIPEI COMPUTER
ASSOCIATION

Sponsor:



TAIPEI WORLD
TRADE CENTER

Venue: TAIPEI WORLD TRADE CENTER EXHIBITION HALL, 5 Hsin Yi Rd. Sec. 5, Taipei, Taiwan, R.O.C.
Tel: 886-2-725-1111 Fax: 886-2-725-1314 Telex: 28094 TPEWTC Branch Offices: CETIX, Inc., New York
Tel: (212)532-7055 Fax: (212)213-4189 Far East Trade Service, Inc., San Francisco Tel: (415)788-4304
Fax: (415)788-0468 Far East Trade Service, Inc., Chicago Tel: (312)819-7373 Fax: (312)819-7377

Circle 433 on Inquiry Card.

Korean Prospects

South Korea's industry will have neither the capital, size nor infrastructure necessary to compete across the boards with this potential Chinese juggernaut. Although in light of the recent establishment of diplomatic relations between South Korea and the PRC and plans for a Special Economic Zone in the north near the Korean peninsula, it may be able to make use of the China labor market. It will, however, be a long time before the infrastructure in the north will even begin to approximate what already exists along the southern coast.

On the other hand, it is not inconceivable that the kind of rapid political changes witnessed in Europe in the last eighteen months will also occur to some degree in Asia. The desire of Koreans for reunification of the peninsula and their fundamental sense of cultural identity transcends whatever countervailing forces may remain from the grafting of a foreign, European economic theory onto the economy of the north. Native Asian mercantilism has always been present at the root of things in both Korea and China, however much Communist regimes may have tried to suppress it or pretend it wasn't there. It is the driving force of China's economic restructuring and will almost certainly be the basis for Korean reunification. When that comes, South Korea will suddenly find itself possessed of a highly disciplined, culturally and linguistically compatible cheap labor force in its own back yard and high-tech industries will be at the top of the list to benefit from it.

In addition, it is uncertain whether there will be any further development of the already limited cooperation between Taiwan and South Korean companies. Although there were formal meetings in Taipei in the late spring to explore the creation of a basis for greater cooperation, South Korea's shifting of diplomatic recognition from Taiwan to the People's Republic has probably queered, for the time being at least, the possibility of building on what little progress was made.

In spite of this, there is still a strong economic incentive for the Taiwanese to purchase components from Korea that they can't yet produce themselves on Taiwan or the mainland. The advantages and reliability of buying South Korean LCD panels and DRAM are more than likely to overcome whatever resentment may still be felt from what was in any case an inevitable development.

The overwhelming necessity to reduce and keep costs down in the face of the destructive price wars in North America and generally flat market world-wide has the effect of making moot whatever political conflicts might exist across the entire region. One of the consistently observable features of almost all Asian development is the prioritization of wealth over the secondary niceties of political philosophy.

Singapore

Singapore, while much farther south and much more diverse a society than Hong Kong or Taiwan, is still predominantly Chinese. Its geographical location at a cultural nexus leaves it more likely poised to become a catalyst for industry development in Southeast Asia rather than being co-opted into the greater Chinese sphere. Indeed this process

Quenching the world's thirst for information systems.

Over 70 countries depend on Tatung for a constant flow of technologically advanced information systems. Like state-of-the art PCs, workstations, notebooks and monitors.

And it's refreshing to know that no other manufacturer in the world offers better service and support for its distributors. Or a better quality control process. In fact, Tatung meets the stringent U.S. Military Quality Control Standard MIL-105D.



TCS-9620E MM17WAP
TNB-700 COMPstation 40

So, if you're thirsting for a steady stream of the world's best information systems, the solution is quite clear. Tatung. It's that pure and simple



has already begun.

Singapore's status as the manufacturing location of choice for many large international computer firms places a concentration of capital, plant and human resources in a position to expand in several directions. This is already resulting in increased investment in very high-tech facility development on the Malaysian peninsula. With no shortage of capital in the region, such investment by multinational companies encourages an acceleration in the of development local firms.

This trend could see Singapore more and more becoming the focal point of high-end research and manufacturing facilities that will dot the region nearby and leave the lower-end products to the Chinese triangle to the north. The area already has more than sufficient infrastructure in place to support this proposition.

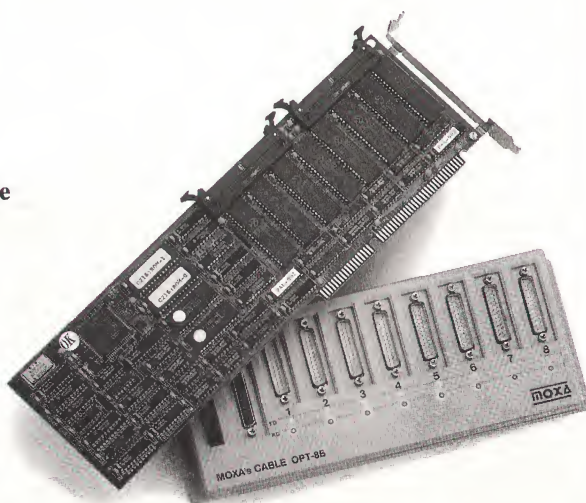
In addition, Singapore and Malaysia enjoy some of the greatest political stability in the region. A state of affairs that cannot be claimed in any other Asian country other than Japan. Questions of political stability, as opposed to conflicts of ideology, are likely to weigh significantly in the estimations of investors both from within and without the region. The potential for disruption of production or delivery due to political strife, while not acute, cannot be dismissed. Certainly not in China, nor in Thailand, Indonesia, the Philippines or even, though less likely, in South Korea and Taiwan.

The economic boom that makes the region so attractive to outside investors has reached the stage where the people in the leading

INTELLIGENT 16-PORT RS-232 CARD

- INTEL 80286 CPU
- 512K memory mapped to 16K system address
- COMMUNICATION RATE: 50 to 57600 BPS programmable
- Download on board firmware
 - Easy for version up-grade
- Support device drivers for UNIX/XENIX, MS-DOS
- EIA RS-232C interface: TXD, RXD, RTS, CTS, DSR, DTR, DCD, GND
- Up to 64 ports per system

For MS-DOS application, We offer a powerful software tool named MOXA API-232 Application Programming Interface for RS-232. It will help your programming and trouble-shooting.



MOXA-C216



404 TECHNOLOGIES INC.
3F, No. 266, Sec. 1, Ho Ping E. Rd., Taipei, Taiwan, R.O.C.
Tel: (886-2) 3627071 Fax: (886-2) 3631431



Powerful, Upgradeable, Flexible, Portable, Reliable....

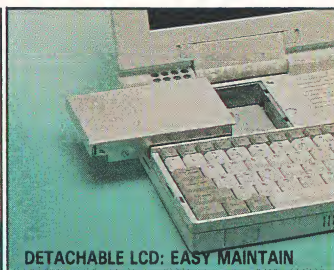


AUVA 445/25, 545/33 SELLING POINTS

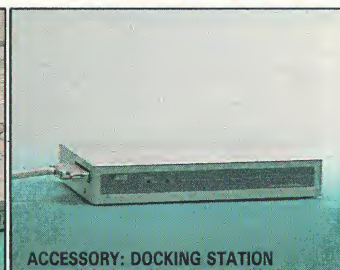
- CPU i80486™ SX-25 MICROPROCESSOR
- CPU i80486™ DX-33 MICROPROCESSOR
- SLIM SIZE & THINNER: 280(L)×225(W)×47(H)mm
- BUILD IN SCANNER PORT
- NON-STOP SYSTEM SECOND BATTERY
- DETACHABLE LCD/EASY MAINTAIN, 10" SIZE
- REMOVABLE HDD/EASY MAINTAIN, UPGRADE & SECURE
- BUILD IN FAX-MODEM: Data 2400pbs, MODEM Fax: 4800pbs Send
- POWER SAVING: SUSPEND/RESUME FUNCTION
- EASY TO INSTALL MICROPROCESSOR WITHOUT OPENING CABINET
- EASY TO EXPAND MEMORY



REMOVABLE HDD: EASY MAINTAIN, UPGRADE & SECURE



DETACHABLE LCD: EASY MAINTAIN



ACCESSORY: DOCKING STATION

SHIPPED FROM THAILAND WITH DUTY FREE!



AUTOCOMPUTER CO., LTD.

NO. 18, Pei Yuan Road, Chung-Li City, Tao-Yuan Hsien, Taiwan, R.O.C.
Tel: (03) 452-8200 Fax: (03) 452-9155 452-8559 Telex: 31271

Welcome!
COMDEX/Fall '92
Nov. 16-20
Booth No. H7004
Hilton Hotel

AUVA COMPUTER CO., LTD., THAILAND
Ladkrabang Industrial Estate(3), No. 381 Chalongsong Rd.,
Kwang Lamplaw, Ladkrabang, Bangkok 10520, Thailand.
TEL: 66-2-3260455-8 FAX: 66-2-3260459

AUVA COMPUTER INC. CA., USA
16851 Knott Ave., Suite B, La Mirada, Ca. 90638, USA.
TEL: (714) 5626988 FAX: (714) 5626980

VIP COMPUTER INC. CA., USA
16851 Knott Ave., Suite A, La Mirada, Ca. 90638, USA.
TEL: (714) 5626993 FAX: (714) 5626990

VIP COMPUTER INC. IL., USA
960 Industrial Dr., #7, Elmhurst, IL 60126, USA.
TEL: (708) 8323080 FAX: (708) 8322858
APEX COMPUTER GmbH. D'DORF., GERMANY
Schiess Str. 46, 4000 Duesseldorf 11, West Germany.
TEL: (211) 596737 FAX: (211) 594317
APEX COMPUTER GmbH. BERLIN, GERMANY
Buckower Chaussee 69-70, 1000 Berlin 48, West Germany.
TEL: (030) 724021-4 FAX: (030) 727046
AUVA COMPUTER GmbH. WIEN, AUSTRIA
Margaretenquertel 12, A-1050 Wien, Austria.
TEL: (431) 5454251/9 FAX: (431) 5454266

AUVA COMPUTER SRL. CILAVENGA, ITALY
VIA Gravelona, 45, 27024 Cilavenga (Pavia), Italy.
TEL: (39381) 969781 FAX: (39381) 969784

AUVA COMPUTER B.V. ROTTERDAM, HOLLAND
Klompemakerstraat 18B, 2984 BB Ridderkerk, Netherlands, Holland.
TEL: (1804) 10911 FAX: (1804) 14840

AUVA COMPUTER AUSTRALIA PTY., LTD., SYDNEY, AUS.
Unit 26, No. 9, CNR, Salisbury Rd. & Hudson Ave., Caste Hill 2154,
N.S.W., Australia.
TEL: (612) 8997176 FAX: (612) 8997187

economies are increasingly demanding a payback on their years of hard work and sacrifice. At the same time, those in the less developed economies of the region are chafing to join in their neighbor's prosperity, but are sensitive to being exploited by the prosperous, especially the Chinese and Japanese, who have a long-standing public relations problem in this regard in South-East Asia.

REGIONAL OPPORTUNITIES

The near-term potentially low-cost locations for the region's expanding computer manufacturers include Thailand, Viet Nam, Indonesia, Malaysia and the Philippines. The experiences of vanguard companies to date indicates a variety of problems in store for large-scale expansion of manufacturing in these locales.

Thailand

In Thailand, Taiwanese companies that attempted several years ago to move production there, before opportunities on the China mainland became politically possible, have had mixed experiences. Problems have run the gamut from component supply and labor difficulties, to shipping and delivery snags. As investment in the China mainland has become possible, interest in further development or new efforts in Thailand has suffered, and the native Thai industry is small and underdeveloped.

Examples of new investment are present however, as attested to by

THAT'S V.32bis FAX/DATA MODEM

STAND ALONE

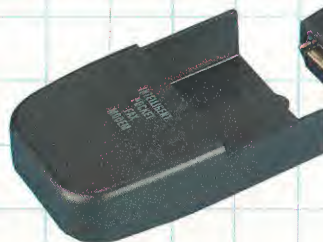
- * HIGH SPEED COMPATIBILITY WITH V.32 bis V.42 bis AND CLASS I, II G3 9600bps S/R FAX
- * ELEGANT DESIGN IN COMPACT LIGHTWEIGHT SIZE
 - DIMENSIONS: 150 X 120 X 30mm
 - WEIGHT: 200 grams
- * 9 OR 25 PIN D CONNECTOR OUTPUT TO PC'S RS-232 SERIAL PORT
- * SUPPORT COMMUNICATION SOFTWARE FOR DOS WINDOWS
- * PATENTED DESIGN No.31626



PORA

PORA CORPORATION
4/F, 196 Cheng Teh Road, 4 Sec
Taipei, Taiwan, R.O.C.
Tel: 886-2-8835579
Fax: 886-2-8835582

PROLINK



COMDEX/Fall '92

16-21 November, 1992
Las Vegas, Nevada, U.S.A.

BOOTH No.S1642B



POCKET:

- * RELIABLE ERROR FREE CONNECTIVITY V.42 V.42bis MNP2-5 AND V.23 PROTOCOL, WITH CLASS II G3 9600bps S/R FAX
- * 90° POSITION ADJUSTABLE RS-232 9 PIN D CONNECTOR
- * PATENTED LOCKING THUMBSCREW DIRECT CONNECTION TO SERIAL PORT
- * DC 9V OPERATION WITH BATTERY AND EXTERNAL AC/DC ADAPTER
- * INTELLIGENT POWER SAVING CIRCUIT
- * REMOVABLE COVER TO PROTECT CONNECTOR AND KEEP IT DUST-FREE
- * DIMENSION: 154 X 60 X 30mm WEIGHT: 170 grams (WITH COVER AND BATTERY)

The desktop for people with no desks!



In these days of laptops, notebooks and palmtops, the very mention of a desktop is likely to turn people off. After all, who needs a great big machine when you can get the same performance from a much smaller package? We couldn't agree more.

That's why we came up with the DIGIlight. It offers all the power of a desktop plus the convenience of a notebook. The DIGIlight is designed for practical people who need plenty of work space plus the flexibility to move around.

The DIGIlight can be easily relocated so the user can plug in his favorite monitor and keyboard, then get down to work with all the power needed to get the job done. And wherever it is, there will be no shortage of desk space!

ITEM	DL-386SX	DL-386DX	DL-486DX DL-486SX
CPU COPROCESSOR	i386SX i387SX	i386DX i387DX	i486DX i486SX
VGA	512K, 1024 X 768, 16 color		
MEMORY	1/2/4/6/8MB	1/4/16MB	
CACHE SIZE	None	32K/128K Cache	
I/O PORTS	2S/IP	2S/IP	
POWER	Power Adapter	Internal Power	
DIMENSION WEIGHT	240X 195 X45(mm)	315 X 225X 70(mm) 3 KGS	



The "Intel Inside" logo is a trademark of Intel corporation.



Circle 438 on Inquiry Card (RESELLERS: 439).



ASIA:
DIGICOM INC.
9FL, NO. 2, LANE 235,
PAO-CHIAO ROAD
HSIN-TIEN CITY, TAIPEI COUNTY
TAIWAN R.O.C.
FAX: 886-2-918-6277
TELEX: 35262DIGICOM
TEL: 886-2-918-6077

EUROPE:
**DIGICOM
EUROPE B.V.**
RIDDERPOORT 4,
2984 BG RIDDERKERK
THE NETHERLANDS
FAX: 31-1804-19815
TEL: 31-1804-11888

U.S.A.
**AMERICAN
DIGICOM CORP.**
CALIFORNIA OFFICE:
1233 MIDAS WAY
SUNNYVALE,
CA 94086 U.S.A.
FAX: 408-245-1584
TEL: 408-245-1580

NEW YORK OFFICE:
125 MICHAEL DRIVE
SUITE 103 SYOSSET,
NY 11791 U.S.A.
FAX: 516-496-2366
TEL: 516-496-2323

TEXAS OFFICE:
1701 GREENVILLE AVE,
SUITE 207 RICHARDSON,
TEXAS 75081 U.S.A.
FAX: 214-480-0199
TEL: 214-480-9998

DIGICOM INC.

one recent European company's development effort to increase production of board level parts and connectors as well as cables. Where the Taiwanese have experienced cultural difficulties with Thai workers and partners, European investment seems to have been somewhat more successful. The prospects for significant development of the native industry in the near future will probably remain limited because of the relative lack of native engineering talent and activist government support for development.

Malaysia

To the south in Malaysia the local situation, while not that different from Thailand, is influenced by the development drive coming up from Singapore. The influx of trained personnel, expertise and international capital is propagating development at the high end without major involvement by the government like that seen in Taiwan.

Cultural similarities with their Singapore cousins and good human resources and industrial infrastructure are facilitating largely troublefree growth in the Malaysian industry. The current situation looks likely to provide the model for future growth.

Indonesia

To the south of Singapore in Indonesia there has been relatively little development to date. Some Taiwanese companies have moved production of low-end, disproportionately labor-intensive products

HI-PERFORMANCE , LOW NOISE SWITCHING POWER SUPPLY PRECISE , LATEST DESIGN COMPTUER CASE



R94487



E144272



LR98205



9226180



A94055



155001



SCANCOM 92
6-9 October, 1992
Gothenburg, Sweden



ZECKS ENTERPRISE CO.,LTD.
6F,NO.111-32 , SEC 4 , SAN HO RD., SAN CHUANG
CITY , TAIPEI , TAIWAN , R.O.C.
FAX : 886-2-2801351
TEL : 886-2-2870799

ZKS-730T(ZKS-730M)
(212x150x150MM)

ZKS-520T(ZKS-520M)
(150x140x85MM)

ZKS-910T
(175x105x55MM)

ZKS-500T
(152x140x72MM)

SWITCHING POWER SUPPLY

**OPTIONAL-FAN CONTROLLED CARD(FAN REGULATOR) IS AVAILABLE FOR YEARS. IT PROVIDES YOU A NOISE SOLUTION

**ALL POWER SUPPLIES COMPLY WITH SAFETY STANDARDS-UL,CSA,TUV,DEMCO,SEMCO,NEMKO, FEMKO

COMPUTER CASE

**A COMPLETE RANGE OF COMPUTER CASE INCLUDING SLIM LINE CASE,DESK-TOP CASE , MINI-TOWER,MIDDLE-TOWER AND TOWER CASE.

**3-DIGIT DISPLAY

**BLACK,WHITE COLOR



Extra 5" Interactive Room



iScreenTM
intelligence on screen

The innovative intelligent iScreen is designed especially for your needs. An additional window for more interaction between you and your monitor.

With simple key operations, iScreen provides excellent and precise image quality. The key to iScreen technology lies in the interactive features on the screen adjustment menus. These menus allow you to adjust display parameters such as brightness, contrast image height, image width and even colors.

The AcerView internal iColor feature matches the monitor display colors exactly with the colors you want, you can adjust the red, green and blue color levels separately.

iScreen is a milestone in the history of the development of monitors. By choosing it, you are empowering yourself with the superiority of the iScreen.

- Super fine 0.28mm dot-pitch display
- Flat square screen delivers sharp focus and minimal edge distortion
- Compatible with VGA, SVGA, 8514/A, XGA, UltraVGA, and CAD/CAM graphics display standards
- Flicker-free 76Hz refresh rate for resolutions up to 1024x768 depending on model
- Video bandwidths of up to 100MHz ensure future display mode compatibility

AcerView 14", 15" and 17" monitors are yours for the taking.



Image Size & Position



Multi-language menu



iColor



Acer Peripherals, Inc.

6, Feng Shu Tsuen, Kweishan,
Taoyuan 33336, Taiwan, R.O.C.
Tel: 886-3-329-4141
Fax: 886-3-329-3922

Sales Offices

USA: Acer America Corp.
Tel: 1-408-432-6200 Fax: 1-408-432-6221
Europe: Acer Computer B.V. : The Netherlands
Tel: 31-40-501-234 Fax: 31-40-529-124
Other Areas: Acer Inc. ALAP Business Unit
Tel: 886-3-489-3188 Fax: 886-3-489-2949

there to try and maintain a profit margin no longer possible with production in Taiwan. But again, the lure and proximity of mainland Chinese opportunities seems to be slowing interest in going so geographically and culturally far afield. While the very low cost of labor may be appealing enough to tempt some, it is unlikely that the near term will see much development, and what there is will probably be in the production of relatively low-tech, high-labor products.

The Philippines

Some time back there was some interest in the potential of the Philippines for computer manufacturers. At that time, the China mainland was not yet fully open to Taiwan investment. There was hope for a resurrection of the Philippine economy, damaged by years of corrupt rule, but now under the auspices of a new administration. The cultural affinity with Europe and North America borne of a colonial past seemed to bode well for investment, if the experiences of other industries were any judge. Such positive expectations have gone largely unfulfilled however.

China has become the location of choice for Taiwan expansion and the few attempts made in the Philippines have been marginally successful at best. Although there has been a democratic transfer of government, the problems remaining from the previous administration's inability to improve the economy or redress social grievances have become acute. Insurgency in the countryside continues unabated although low key.

Infrastructure is so seriously strained that the government has not even been able to reliably supply electricity to the capital city in recent months. These factors coupled with repeated natural disasters that strain the national treasury make it unlikely that further high-tech development will take place in the near future.

Viet Nam

The dark horse in the race to attract computer sector investment in Southeast Asia is Viet Nam. Coming out of an extended period of isolation, Viet Nam's leaders are determined to put the country on track for development of all kinds. While still hindered by the Bush administration's refusal to fast track a rapprochement between the U.S. and its former opponent, the Vietnamese are seizing every opportunity to encourage investment.

In the meantime, European and Asian companies are quickly filling the void left by the Americans. Many companies have completed preparations to move into Viet Nam, are currying relationships with important officials and are set to move. Japanese and European firms have been particularly active, while some Taiwanese computer companies are already testing the waters with small factories in place. Again, colonial history and geographic proximity leave Viet Nam well placed to work with both Chinese and, of course, French investors. While it might seem unlikely, the Vietnamese truly seem to harbor little rancor towards their former enemies and are quite willing to let economic pragmatism rule the day.

Much of the country remains desperately poor however and it seems that the degree of interest and excitement generated to date may not be matched by results that justify it in the near future. The potential remains undiminished however. The probability of the Americans relenting, if for no other reason than economic self-interest, is significant.

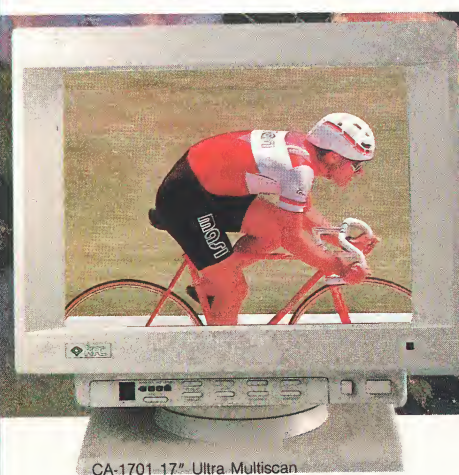
The removal of the American obstacle is likely to unleash a wave of currently pending investment. Viet Nam's location near Hong Kong, shipping lanes and China, and the eagerness of its people to escape the legacy of years of war and oppression may result in the country being a larger participant in the regional diversification of computer manufacturing facilities than might otherwise be thought.

SUMMARY

From all of this it quite evident that rather fundamental change is taking place in the structure of the Asian computer industry. Originally Japan was the only significant force and the industries in the four dragons were nothing more than poor relations feeding on the fringes by producing copycat products, often without benefit of having bothered to consider issues of intellectual property. Later, the dragon industries developed in their own right and began to play both a larger and more responsible role in the creation of an Asian information industry

Those industries have now reached the point where they can no longer profitably expand from their own industrial base and we are seeing the regional diversification of the industry as it grows in size and strength. The division of labor already in process will continue. This provides the Asian industry collectively with advantages Europe and North America cannot hope for any time soon.

In the intervening period, Asian companies will continue to gain in



KFC MONITORS More Than You Expect...

KFC USA, INC.

1585 SUNLAND LANE,
COSTA MESA,
CA 92626 U.S.A.
TEL: 714-546-0336
FAX: 714-546-0315

COMDEX/ Fall '92

16-21 November, 1992
Las Vegas, Nevada, U.S.A.
SAND'S EXPO CONVENTION CENTER
BOOTH NO. S4046E

- Low Radiation
- Non-Interlaced



With KFC, you need not sacrifice performance and comfort to safety.

KFC has been in the monitor industry for eight years. During this time, we have designed and produced monitors for the world's most critical OEM customers and distributors.

We offer a full line of high-performance monitors. Come to KFC and you will get products of a quality you can always count on!

	14" Color				15" Color	17" Color
Model/Spec. Description	CK-1420 (38K) VGA Multiscan	CK-1420N (48K) VGA Multiscan	CM-1410 Multiscan	CM-1413 Multiscan	CA-15 Multiscan	CA-1701 Multiscan
H. Freq.	30-38 KHz	30-48 KHz	30-50KHz	30-60KHz	30-66KHz	30-75KHz
Dot Pitch	.28mm	.28mm	.28mm	.28mm	.28mm	.26mm
Resolution	1024 x 768	1024 x 768	1024 x 768	1024 x 768	1024 x 768	1280 x 1024

*MB-0931 Mono VGA & MA-0931 9" Mono Monitors are also available.

NOVEMBER 1992 • B Y T E 1841ST-17



Kuo Feng Corporation

Head Office;
Suite 602, 136 Jen-Ai Rd., Sec. 3 Taipei, Taiwan, R.O.C.
TEL: (886) 2 754-8353 FAX: (886) 2 754-8498

Specifications are subject to change without notice. All trademarks and registered trademarks are the property of their respective companies.

Circle 434 on Inquiry Card (RESELLERS: 435).

strength both from their own efforts and from investment from outside the region. It is this head start that will be the factor that contributes most to the possibility of the Asian industry eventually becoming financially, if not technologically dominant at the dawn of the "Pacific century."

Europe holds out the possibility of exploiting cheap Eastern European labor and American eyes are cast south, but Asia's head start will be very difficult to compete with, particularly in the face of the scarcity of resources in America and the economic and political confusion being engendered by Europe's half-hearted attempts at economic and perhaps political union.

There is little doubt that technological leadership will continue to flow from the companies of the industrialized club, but coming developments in Asia seem poised to ensure that the process of globalization in the industry will continue, and will ultimately work to the benefit of all concerned.

Taiwan Resource Guide

404 TECHNOLOGIES INC.

Fl.3,NO.266,SEC.1, Ho Ping E.Rd.
Taipei,Taiwan R.O.C.

TEL:886-2-3627071

FAX:886-2-3631431

MITAC INTERNATIONAL CORP.

8th Fl.,NO.75,Ming Sheng E Rd.,Sec.3
Taipei, Taiwan, R.O.C.

TEL:886-2-5018231

FAX:886-2-5014265

ZECKS ENTERPRISE CO.,LTD.

7th Fl.-1,3 Wu Chuan 1st Rd.
Hsinchuang, Taipei, Taiwan, R.O.C.

TEL:886-2-2992022

FAX:886-2-2992027

ULTIMA ELECTRONICS CORP.

9F,No.18,Alley 1,Lane 768,Sec.4,Pa Te Rd.
Taipei, Taiwan, R.O.C.

TEL:886-2-7885470

FAX:886-2-7885657

TECHPOWER CO., LTD.

20th Fl., No. 1058, Minsheng E. Rd.
Taipei, Taiwan, R.O.C.

TEL:886-2-753-1930

FAX:886-2-753-1940

TATUNG CO.

22 Chungshan N.Rd.,3rd Sec.
Taipei, Taiwan, 104, R.O.C.

TEL:886-2-5925252

FAX:886-2-5915185

KUO FENG CORPORATION

Suite 602,136 Jen-Ai Rd.,Sec 3,\
Taipei, Taiwan, R.O.C.

TEL:886-2-7548353

FAX:886-2-7548498

CATHAY COMPUTER & TECHNOLOGY INC.

7F.,85 Chien Kuo N.Rd., Sec 2.
Taipei, Taiwan, R.O.C.

TEL:886-2-5069326

FAX:886-2-5068929

UNITED HITECH CORP.

7F-1., No. 1, Wu Chuan 1 Rd., Hsin Chung City
Taipei, Taiwan, R.O.C.

TEL: 886-2-2993125

FAX: 886-2-2993210

DIGICOM INC.

9th Fl., No. 2, Lane 235, Pao Chiao Rd.,
Hsin Tien City, Taiwan, R.O.C.

TEL: 886-2-9186077

FAX: 886-2-9186277

PORA CORPORATION

4/F, 196 Cheng Teh Rd., Sec. 4
Taipei, Taiwan, R.O.C.

TEL: 886-2-8835579

FAX: 886-2-8835582

YUAN TECHNOLOGY U.S.A.

1223, S. Dorsey Lane #203
Tempe, AZ 85281 U.S.A.

TEL: 602-966-1557

FAX: 602-966-1671

AUTOCOMPUTER CO., LTD.

No. 18, Pei Yuah Rd., Chung Li
Industrial Park, Tao Yuan District

TEL: 886-3-4528200

FAX: 886-3-4525931

ACER PERIPHERALS, INC.

No. 6, Lin 2, Fengshu Tsun
Kweishan Hsiang, Taoyuan Hsien
Taiwan, R.O.C.

TEL: 886-3-3502311

FAX: 886-3-3502312

The advertisement features a large, stylized graphic of a clapperboard. The word "Multi-Media" is written across the top of the clapperboard in a large, colorful font. The clapperboard itself has a black and white striped top bar. Below the title, the text "IDEA Multi-Media" is written. The "PRESENT" line reads "CATHAY". The "FAX" line reads "886-2-5068929". A red stamp diagonally across the bottom right of the clapperboard reads "GREAT SHOW OF SOUND & VIDEO, VOICE & IMAGE TO EVERYONE". To the left of the clapperboard, there is an illustration of a computer system including a tower unit, a monitor, and a keyboard.

CATHAY COMPUTER & TECHNOLOGY INC.
7F, 85 CHIEN-KUO N. RD., SEC. 2, TAIPEI, R.O.C.

TEL: 886-2-5069326
FAX: 886-2-5068929

DATATRONICS TECHNOLOGY, INC.
15/2F, Lane 768, PA-Teh Rd., Sec.4
Taipei 105, Taiwan, R.O.C.

TEL:886-2-7820002
FAX: 886-2-7820305
TELEX:28440 DTXMODEM

**CHINA EXTERNAL TRADE
DEVELOPMENT COUNCIL**
Taipei World Trade Center Exhibition Hall
5 Hsin Yi Road, Sec.5
Taipei, Taiwan, R.O.C.

TEL:886-2-725-1111
FAX:886-2-725-1314
TLX:28094 10571 TPEWTC

TELSPEED CO., LTD.
P.O. BOX 9-12
3rd Fl.234, Chuang Ching Rd.
TELEX:12979 JANSUPER TAIPEI


TEL:886-2-722-9891
FAX:886-2-723-6920

SINETEC TECHNOLOGY CO., LTD.
4F, No.13, Lane 222, Lien Cheng Rd.
Chung Ho, Taipei, Taiwan, R.O.C.

TEL:886-2-2258846
FAX:886-2-2250485

TOPTEK MECRO COMPUTER INC.
5F, No.11, Lane 163, Shing-Yi Rd.
Panchiao City, Taiwan, R.O.C.

TEL:886-2-9647096
FAX:886-2-9619586
BBS:886-2-964-7081



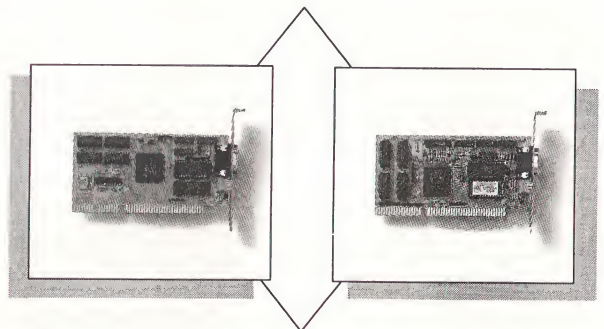
W/HAT
ARE THE SMART QUICK UPS SERIES?

PRODUCT RANGE : ALL ARE COMPATIBLE WITH NETWORK SYSTEMS.
SMART QUICK UPS SERIES :
OFF-LINE : 400VA, 600VA, 800VA, 1000VA & 1250VA.
ON-LINE : 750VA (500 WATTS)

SineTec **SINETEC TECHNOLOGY CO., LTD.**
4F, No.13, Lane 222, Lien Cheng Rd. Chung Ho, Taipei, Taiwan R.O.C.
TEL : 886-2-2258846 FAX : 886-2-2250485

SCREEN AUTO SHUT OFF VGA BOARD

VGA CARD BUILD WITH HARDWARE
SCREEN SAVER FUNCTION
US PATENT NO 5059961



THOSE VGA CARDS BUILD WITH HARDWARE SCREEN SAVER FUNCTION, IT MEANS YOU CAN HAVE SCREEN SAVER FUNCTION IN ANY OPERATION SYSTEM DON'T MATTER IT IS DOS, UNIX, WINDOWS, OS/2, ALSO IT COMPATIBLE TO ANY SOFTWARE, AND WITHOUT SLOW DOWN YOUR SYSTEM PERFORMANCE.

TELSPEED COMPUTER CO., LTD.

P.O. BOX 9-12
3RD. FL. 234, CHUANG CHING RD.
TAIPEI, TAIWAN R.O.C.
TEL : 886-2-7229891, 7200430 FAX : 886-2-7236920

A PLATFORM FOR SIGNAL COMPUTING

Analog Devices couples a reprogrammable signal processor
with a standard API to create an open platform

TIM COUNIHAN

Signal computing integrates dynamic, new real-time data types into the static world of data processing. In turn, these data types will move your computer interface beyond the GUI to the point where even neophytes will feel comfortable using a computer.

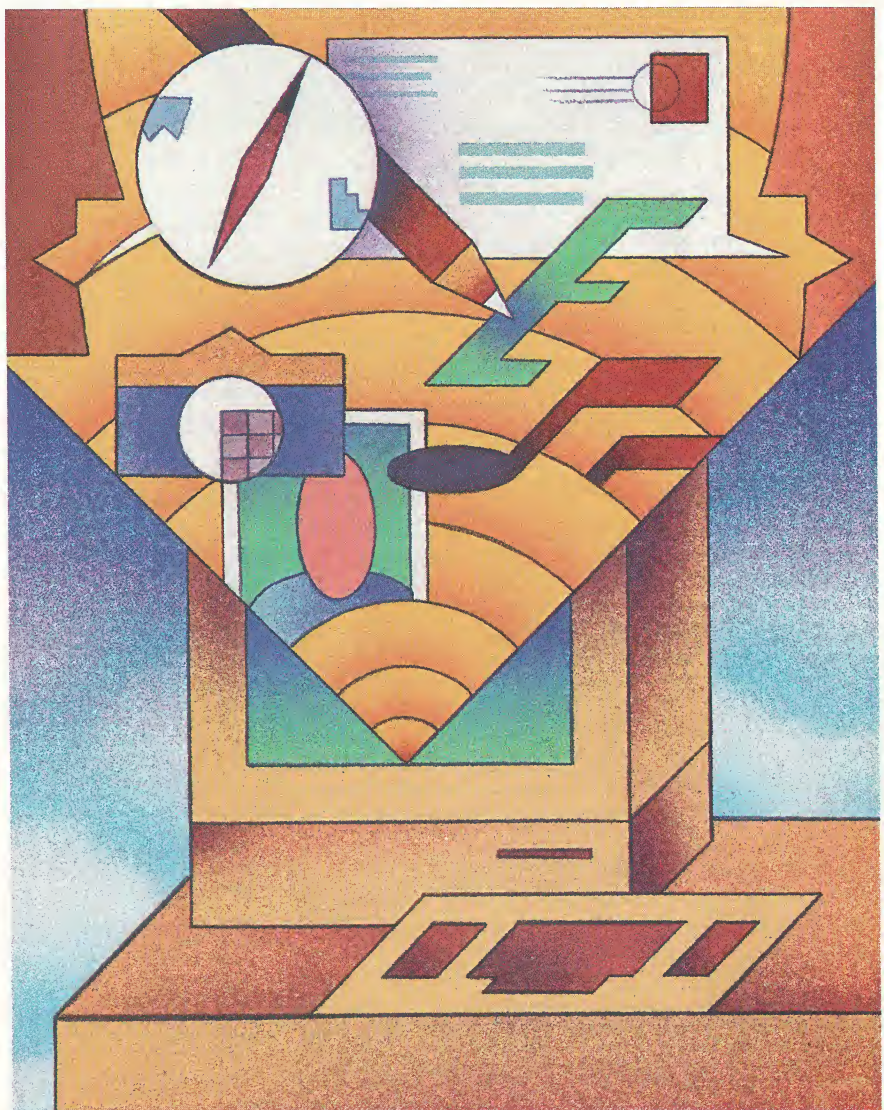
Analog Devices has developed an open, reprogrammable signal-processing environment capable of manipulating these real-time data types. This is an environment for real-time, signal-based software applications, developed and run on a reprogrammable signal processor under the control of host-based applications. Within this environment, applications-specific signal I/O ports acquire and generate the real-time signal I/O.

The primary data types of this environment are voice, audio, wired and wireless communications streams, and video. With such a platform, you can bring real-time multimedia applications (e.g., digital photography, high-speed image compression, language translation, and teleconferencing) to the desktop.

Multimedia Signals

Many of the above applications already exist. However, each one usually has its own proprietary plug-in hardware platform, with its own signal processor, memory, signal I/O peripherals, proprietary host interface, proprietary applications monitor, and proprietary applications code. Because these were developed as stand-alone, fixed-function applications, it is expensive and difficult to incorporate them into other personal computer-based software.

A low-cost signal processor (supported by inexpensive signal I/O ports and



SIGNAL COMPUTING

IEEE-488

You can control any IEEE-488 (HP-IB, GP-IB, 488.2) device with our cards, cables and software for the PC/AT/386, EISA, Micro Channel and Macintosh II. You get fast hardware and software support for all the popular languages, plus a software library of time saving utilities. Instrument control has never been easier.

FREE
Informative Catalog **800-234-4CEC**
Applications help **617-273-1818**

cec Capital Equipment Corp.
Burlington, MA. 01803

Micro Channel is a trademark of IBM

open software standards), coupled with an open software environment, can generate the widest developer base and, consequently, the greatest variety of applications. Software developers will be able to license these turnkey signal-processing libraries from entrepreneurial signal-processing experts and incorporate the new data types into their own applications.

Soft Modems

Two years ago, Ken Kretchmer of Action Consulting (Palo Alto, CA) described a soft modem as a modem that uses a totally RAM-based signal processor to implement all the controller functions (e.g., V.42bis and the Hayes AT commands) on the same signal processor that runs the V.32bis modulation algorithms. Kretchmer projected that the modem would be the first signal-processing application to achieve true software status, where all the modem's software algorithms resided in memory.

Digicom Systems (Milpitas, CA) held the same view and pioneered in the use of reprogrammable signal processors in high-performance modems. Last June, at the New York PC Expo, Digicom became the first modem manufacturer to announce a soft modem, the first signal-computing software product providing throughput of up to 57,600 bps and using the 14,400-bps V.32bis with V.42bis data compression.

In addition, the modem includes Group 3 V.29 fax, all modem and fax fallback standards, and controller functions, such as the AT+Voice command set, MNP level 5, and class 1 fax. For less than \$30, personal computer integrators are able to purchase all this software and two chips: a reprogrammable signal processor and a modem front end.

Beyond Data Processing

Analog Devices sees signal computing as an industry model to enable the open development and use of real-time signal-processing applications. It has defined inexpensive, reprogrammable chip sets and developed a nucleus of IAVs (independent algorithm vendors) to leverage signal computing's development.

Two unique features of the signal-computing chip set are its reprogrammability and extensibility. First, Analog Devices'

product is RAM-based. The modem can be reprogrammed, patched, enhanced, and upgraded through software. This is especially valuable to closed hardware platforms (e.g., laptops and palmtops). Second, the chip set is based on an inexpensive, general-purpose 16-bit DSP (digital signal processor), and the companion chip is a fully integrated modem front end. At an integrator's discretion, additional signal I/O ports (providing voice I/O, stereo audio I/O, and so forth) can be added to the base chip set. Voice-recognition, text-to-speech conversion, or music-synthesis software can also be added to incrementally extend the base chip set's capabilities. Speech recognition, music synthesis, and image compression become software products that essentially run on your fax/modem.

Signal-Processing Data Types

The major difference between signal processing and data processing is the real-time nature of the data being processed. Real-time data is simply a signal (e.g., an audio waveform) that is sampled or generated in real time. Signal processors are designed to handle the unique numerical requirements of processing real-time data and to interface with real-time signal-acquisition components.

Modems compress data into real-time communications streams to fit narrow-band channels. Similarly, high-speed wired networks, infrared LANs, mobile radios, and satellite RF links use signal processors to compress and decompress data in real time. If a real-time processor fails to process a millisecond or two, the consequence is lost signals, resulting in garbled voice or corrupt data.

Voice applications (e.g., cellular phones and digital answering machines) require real-time signal I/O at frequencies as high as 8 kHz for compression and up to 16 kHz for speech recognition (to capture the high-frequency voice tones, such as an s). Audio applications (e.g., digital stereo playback, music synthesis, and digital stereo recording) require real-time signal I/O at frequencies as high as 48 kHz to capture high-frequency audible signals, such as crashing cymbals. And motion video requires real-time signal I/O at frequencies between 1 and 30 MHz, depending on the size and update frequency of the image.

Many other real-time signal-processing systems (e.g., noise cancellation and encryption) require lossless I/O. The lossless characteristic of real-time signal I/O places burdens on the signal processor, especially on its architecture, I/O peripherals, and interrupt capabilities. The signal processor needs the computational bandwidth

Signal-computing components

- reprogrammable signal processor
- signal I/O devices
- algorithms for natural data types
- open hooks for applications

SIGNAL COMPUTING

to process the signal data within the sampling frequency. Although data processors can handle some real-time signal applications, they were not designed for these tasks.

Signal I/O

To incorporate real-time data types into a personal computer, you need real-time signal I/O ports or mixed-signal peripherals. Such devices preserve the information contained in a signal while transforming its format into one appropriate for the next stage in its journey—for either processing or transmission. They must be capable of sampling the signal stream at a frequency appropriate for the data type with the necessary accuracy or fidelity. They must also be able to preprocess the acquired data. When generating signal output, the devices should postprocess the digital data stream and output signals with a data type-appropriate frequency, accuracy, phase, and gain. When used in signal-computing environments, the devices should easily interface with the signal processor.

Third-party companies are integrating audio-band I/O ports into the A/D-signal-computing platform. Wireless communications and video I/O ports (e.g., base-band I/O and infrared/RF components, video-capture boards and scanners, and real-time video-compression components) will be designed into the integrated personal computers of the future. Note that the performance of these signal I/O ports is just as important to signal computing as the performance of the keyboard, disk drive, mouse, and display is to personal computing.

PSTN (public switched telephone network) applications on a personal computer (e.g., modem, fax, and speech) require a direct-interface, single-chip, echo-canceling front end. This component must handle standard sampling frequencies and include on-chip resampling/interpolation filters for real-time signal synchronization and phase adjustment.

Voice I/O applications require a linear voice-band codec that provides a direct interface with a signal processor, a microphone, and an amplified speaker. The codec should offer on-chip antialiasing and anti-imaging filters and good group-delay characteristics that simplify acoustic echo cancellation when the signal is to be broadcast in mobile (i.e., wireless) computer environments.

Audio applications require a single-chip, 16-bit, stereo audio-band codec, which provides a direct interface with the data processor or signal processor; stereo line-level inputs and outputs; stereo mi-

crophone-level inputs; and speaker outputs. The audio codec should have on-chip programmable gain amplifiers and automatic-calibration circuitry, as well as support the full spectrum of personal computer audio-sampling frequencies between 8 and 48 kHz.

Video I/O ports will be designed into the integrated personal computers of the future.

Signal I/O ports must also be fully integrated and designed to provide the functionality required by a wide variety of applications for a given signal data type. They will be fabricated with CMOS-process technology at both 5-volt and 3-V levels to enable the signal ports' integration into the chip sets of the future.

PS/2® MEMORY

Introducing OS/RAM32plus™ for the Micro Channel™

- ✓ Provides from 2 to 128 Mbytes of fast memory.
- ✓ Works in 16 or 32 bit mode to meet your needs.
- ✓ Provides extended and expanded memory.
- ✓ Fast software and hardware for LIM 4.0 included.
- ✓ Automatic configuration for DOS, OS/2 and UNIX.
- ✓ Easy to install. Risk free guarantee. Two year warranty.
- ✓ Add a disk cache and RAM disk using OS/RAM32plus to get maximum performance from your computer.
- ✓ Free up low memory by moving your drivers and TSR's to OS/RAM32plus. We guarantee compatibility!

Call today 617-273-1818 or 1-800-234-4CEC

cec Capital Equipment Corp.
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

Signal-Computing Applications

Today, signal processors are pervasive in communications systems such as high-performance modems, digital mobile radio, digital cordless telephony, satellite communications, and videophones. Narrow-band communications channels require the compression and reconstruction of data, and signal processors are the engines.

Voice and data compression are also used in such applications as voice mail, digital answering machines, and data compression for floppy/hard-disk conservation. Real-time data types take up a lot of hard disk space. Even compressed, a minute of motion video can fill a hard drive. More efficient algorithms are being developed to reduce channel usage and data-storage costs.

Digicom Systems, Specom (Santa Clara, CA), and Lernout & Hauspie Speech Products (Ieper, Belgium) are the first IAVs to provide data- and voice-compression technology for communications applications within the signal-computing environment. Digicom provides modem and fax capability. Specom provides CELP (code excited linear prediction) and TIA IS-54 VSELP voice compression capability. And LHSP provides SBCELP.

Signal processors are pervasive in speech-recognition and speech-synthesis applications (e.g., voice navigation, hands-free/eyes-free control, security access control,

The Signal-Computing Environment

The essence of signal computing lies in the integration of three fundamental competencies into a signal-processing solution: signal I/O ports, signal-processing software, and a reprogrammable, digital signal processor.

The signal I/O ports capture or generate the applications' signals, converting them back and forth between the analog and digital domain. In the figure, there are three signal I/O ports:

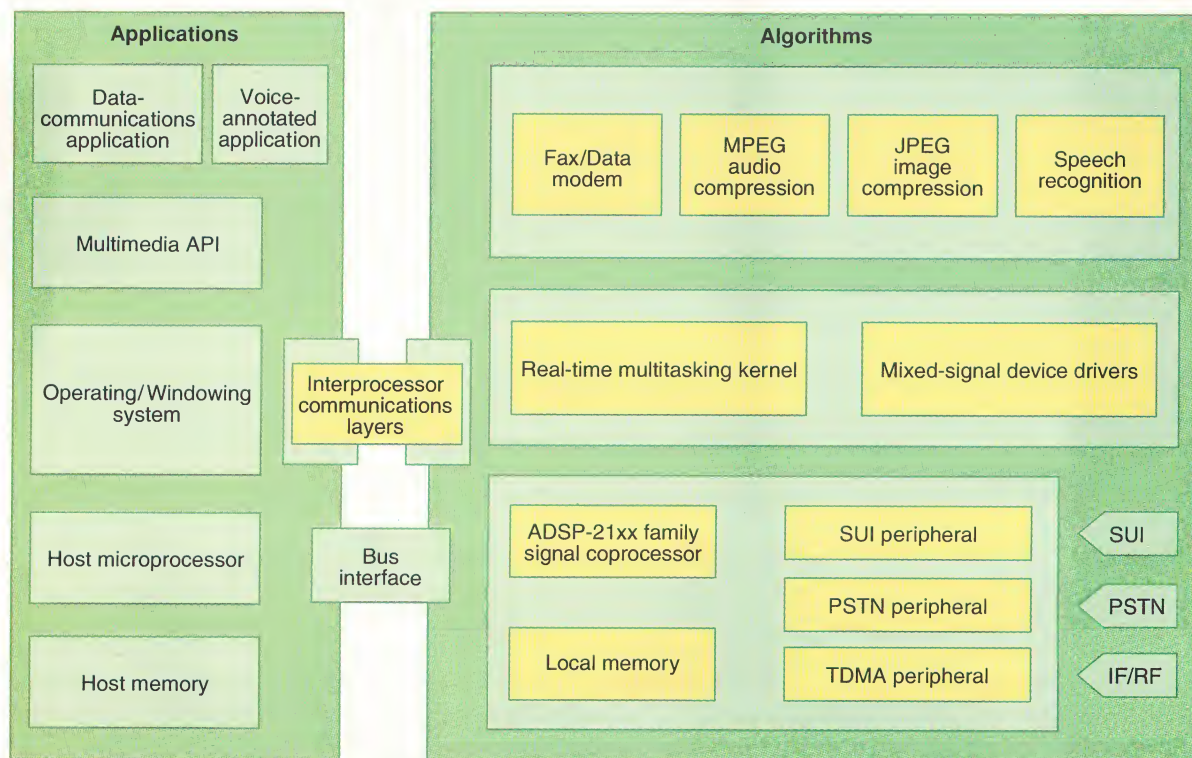
a SUI (Sound User's Interface), which provides voice- or audio-quality I/O; a PSTN (public switched telephone network) interface, which connects to the phone lines for modem and fax I/O; and a TDMA (Time Division Multiple Access) peripheral, which connects to infrared/RF transmit and receive components for wireless communications.

The algorithm software performs the mathematically complex and intensive signal-processing algorithms. The figure

shows algorithm code for a fax/data modem, MPEG audio compression, and speech recognition. When not in use, the code resides on the personal computer. It's downloaded as necessary by the host processor.

The signal coprocessor provides the mathematical horsepower to process the signal-computing algorithms. It has support circuitry to interface with the signal I/O ports, as well as with a host

THE PERSONAL COMPUTER-DSP CONNECTION



Using the abstraction of a multimedia API, the signal processor and its algorithms are invisible to host-based applications. Interprocess communications between the signal-computing platform and the host are bus-independent, letting the signal processor reside on a motherboard, on an expansion card, or in a peripheral device.

processor. The signal-computing applications' RAM sits alongside the signal processor, enabling the reconfigurability of the signal-computing engine.

As signal-computing applications grow and become more complex, there will be an increasing need for a real-time multitasking kernel and mixed-signal device drivers. Spectron Microsystems (Santa Barbara, CA) has pioneered in the standardization of the DSP operating system with SPOX. The company has also defined and standardized an OSPA (open signal coprocessing architecture) for layered host/DSP interprocessor communications. These software tools decouple the algorithm code from the signal processor and the signal I/O port hardware and enable the portability of applications software. OSPA and SPOX work with signal processors from Analog Devices, Motorola, and Texas Instruments.

On the applications side of the signal-computing environment are the traditional components of most personal computer applications: the host microprocessor, its memory, the operating/windowing system, and applications software. In the figure, a data-communications application and a voice-annotation application access the signal-computing software. These applications can be databases, spreadsheets, word processors, or yet-to-be-developed programs.

APIs are also needed to provide applications with standardized calls to the signal processor. The Interactive Multimedia Association, Spectron Microsystems (with its MINT [Media Integration] architecture), and other applications groups are standardizing multimedia and signal-processing APIs for use by independent software developers. These standards will be determined by the free-market interaction of the IAVs and the software developers.

and text-to-speech conversion). Speech systems can have various vocabularies, languages, training requirements, and accuracy rates; be continuous or discrete; and use options such as word spotting, lexical and syntactic analysis, and semantic processing. Speech recognition and speech synthesis rely on constantly evolving algorithms for vector quantization, acoustic and language models, neural networks, hidden Markov models, and expectation maximization. In a signal-computing environment, you can incorporate these im-

Signal processors will soon be found in car audio systems for improving stereo imaging.

provements with shrink-wrapped software upgrades.

LHSP provides speech-recognition and speech-synthesis technology for speech I/O integration within the signal-computing framework (see the text box "Digitally Speaking" on page 160). LHSP provides speaker-independent and speaker-adaptive American English, German, French, Spanish, Dutch, and Korean speech-recognition and speech-synthesis systems. And it is working on systems for Japanese, Italian, British English, South American Spanish, and tonal languages (e.g., Mandarin and Cantonese). All the systems use a text-to-speech conversion tool called DEPES (Development Environment for Pronunciation Expert Systems) for rapid language development.

Digital Audio

Signal processors are widely used in audio and electronic music. Music synthesizers use signal processors as envelope generators and as digital oscillators to create various voices and such effects as tremolo and pitch blending. One of the first applications of signal processors was in professional audio for delay and artificial reverberation. Now DSPs are also being applied in consumer audio for such functions as surround-sound decoding and equalization. In the near future, signal pro-

cessors will be found in car audio systems for canceling noise or improving stereo imaging.

One IAV working in this area is EuPhonics, whose first algorithm toolkit will be an implementation of Dolby Laboratory's AC-2 audio-compression algorithm, which provides a 6-to-1 reduction of storage requirements for CD-quality audio, with no audible degradation of the sound. EuPhonics also plans to offer unique digital synthesis algorithms that will improve the quality of FM synthesis components that are used in popular add-in cards, such as SoundBlaster from Creative Labs (Santa Clara, CA).

Digital Imaging

Signal processors are widely used in static imaging (e.g., graphics accelerators and digital photography), CAT scanners, magnetic-resonance imaging, satellite imaging, and bar coders. They are also used in real-time imaging applications, such as videophones, radar, and sonar.

One IAV with offerings in the imaging field is Xing Technology (Arroyo Grande, CA), which will initially provide CCITT JPEG (Joint Pictures Experts Group) image-compression algorithms and CCITT MPEG (Motion Pictures Experts Group) audio-compression algorithms. Xing Technology is active on the JPEG, MPEG, and Interactive Multimedia Association committees and has developed its software products using a scalable compression architecture. In real-time video, the viewed size, compressed size, refresh rate of the image, and quality of the image can be scaled to the computing resources available. Future IAVs will offer print- and curative-handwriting-recognition software, as well as graphics and digital-imaging algorithms.

Signals in Your Future

Analog Devices created an open signal-computing platform to move the power of DSP beyond proprietary constraints. It's an environment for real-time, signal-based software applications. With this platform, you can bring real-time multimedia computing to your desktop.

Analog Devices has defined low-cost, reprogrammable chip sets for this platform. But, as with the original personal computer, the success of the platform depends on the imagination and hard work of applications developers. ■

Tim Counihan is the strategic marketing manager for signal processors at Analog Devices (Norwood, MA). You can contact him on BIX c/o "editors" or on the Internet at tim.counihan@analog.com.

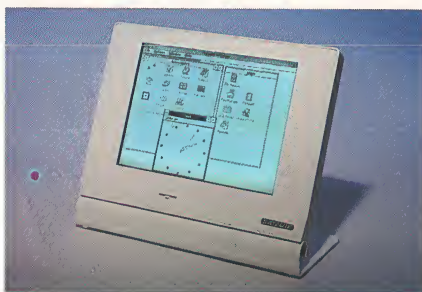
Space - Savers

Popular Space-Saver Keyboard £79.00



First successful alternative to conventional keyboard saves 60% desk space with a foot print of 27.3 x 15.2 cm. Has full travel tactically responsive keys with standard left-right spacing for easy touch typing. 100 keys, compatible with IBM XT/AT PS/2. Many language versions available.

Stand-Alone LCD Monitor £799.00



This 10" black on white monitor is easy-to-read, yet compact. Resolution is 640x480 with sharp, flicker-free image. Sharp's high refresh rate, triple supertwist nematic technology with back lighting provides a super bright, low radiation screen with a wide viewing angle. The adjustable monitor base is only 29x14 cm. It lets you mount the LCD monitor on vertical surfaces or fold for transport. Comes with 1.5 m cable and VGA adaptor card. No external power required. IBM AT compatible.

NEW

Diskless LANStation £1599.00



Combines Space-Saver Keyboard, LCD Monitor and 20 Mhz 386sx CPU w/2 Meg RAM (4 Meg optional) in a single very small footprint (27.4 X 26.0cm). Network ready with 10 Base2, 10 BaseT NE-2000 compatible network adapter built-in. Unit does not fold for portability.

**To Order In Europe Call 44-306-876718
Fax 44-306-876742**

1 year warranty on all products shown. Order direct from stock with 15 day full return privileges. Visa, Master/Eurocard charges and COD accepted. OEM and reseller volume discounts available.

Also Stocked & Serviced in: AUSTRALIA Tel 2-908-2777 • Fax 2-908-2331

DATALUX

First Choice In Space-Saver Peripherals

Euro House • Curtis Road, 11 Old Water Yard • Dorking, Surrey
UNITED KINGDOM, RH41EJ • Phone 306-876718 • Fax 306-876742

RESOURCE GUIDE

DSP-Based Products

The following list is a sampling of products in a range of categories that incorporate DSP technology.

ARRAY PROCESSORS

Eighteen Eight Laboratories
1247 Tamarisk Lane
Boulder City, NV 89005
(800) 888-1119
(702) 294-1051
fax: (702) 294-2611
PL1250 (PC, Xenix)
PL2500 (PC, Xenix)
Circle 1000 on Inquiry Card.

Image and Signal Processing Corp.
120 Linden Ave.
Long Beach, CA 90802
(310) 495-9533
fax: (310) 495-1258
AP-4, 4E, 6 (proprietary)
Point (PC)
Circle 1001 on Inquiry Card.

Olsson Engineering
561 Pine St.
Edmonds, WA 98020
(206) 778-9480
fax: (206) 771-3994
DSP200 (VME bus)
Circle 1002 on Inquiry Card.

AUDIO/VIDEO BOARDS

Antex Electronics Corp.
16100 South Figueroa St.
Gardena, CA 90248
(800) 338-4231
(310) 532-3092
fax: (310) 532-8509
AV-16 Audiographics (PC)
Circle 1003 on Inquiry Card.

Echo Speech Corp.
6420 Via Real
Carpinteria, CA 93013
(805) 684-4593
fax: (805) 684-6628
Echo DSP (PC)
Echo Speech Processor DSP (Unix)
Circle 1004 on Inquiry Card.

Singular Solutions
959 East Colorado Blvd.
Pasadena, CA 91106
(818) 792-9567
fax: (818) 792-0903
A/D64x (Next)
Circle 1005 on Inquiry Card.

COMMUNICATIONS

Shiva Corp.
1 Cambridge Center
Cambridge, MA 02142
(800) 458-3550
(617) 252-6400
fax: (617) 252-6852
NetBridge (Mac and LocalTalk)
Circle 1006 on Inquiry Card.

DSP BOARDS

Ariel Corp.
433 River Rd.
Highland Park, NJ 08904
(908) 249-2900
fax: (908) 249-2123
DSP-16 Plus (PC)
DSP-32C (PC)
Circle 1007 on Inquiry Card.

DSP Technology, Inc.
48500 Kato Rd.
Fremont, CA 94538
(510) 657-7555
fax: (510) 657-7576
Model 4325 (PC)
Circle 1008 on Inquiry Card.

GRAPHICS BOARDS

Matrox Electronic Systems, Ltd.
1055 St. Regis Blvd.
Dorval, Quebec, Canada H9P 2T4
(800) 361-4903
(514) 685-2630
fax: (514) 685-2853
M-Win 1280 D (PC)
Circle 1009 on Inquiry Card.

Seaport Imaging
1340 Saratoga-Sunnyvale Rd.,
Suite 104
San Jose, CA 95129
(408) 366-6400
fax: (408) 366-6406
Seaport VIP-20 (PC, PS/2)
Circle 1010 on Inquiry Card.

IMAGE-PROCESSING BOARDS

Dipix Technologies
1050 Baxter Rd., Unit 7
Ottawa, Ontario, Canada K2C 3P1
(800) 724-5929
(613) 596-4942
fax: (613) 596-4914
P360 Power Grabber (PC)
Circle 1011 on Inquiry Card.

Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation.

FUNCTION POPADDR
 PARAMETERS NAME
 PRIVATE ADDRESS, ZIP CODE, CITY
 ADDRESS = SPACE (30)
 ZIP CODE = 0
 CITY = SPACE (30)
 SET COLOR TO W/N
 CLEAR SCREEN
 @ 2,10 SAY NAME
 @ 3,10 SAY "Address"
 @ 4,10 SAY "Zip"
 @ 5,10 SAY "City"
 @ 3,30 GET ADDRESS
 @ 4,30 GET ZIP CODE
 @ 5,30 GET CITY
 READ
 RETURN .T.

FUNCTION POPADDRS (NAMES)
 ADDRESS\$ =
 ZIP CODE = 0
 CITY\$ = " "
 COLOR 7,0
 CLS
 LOCATE 2,10 : PRINT NAMES
 LOCATE 3,10 : PRINT "Address"
 LOCATE 4,10 : PRINT "Zip"
 LOCATE 5,10 : PRINT "City"
 LOCATE 3,30 : INPUT ADDRESS\$
 LOCATE 4,30 : INPUT ZIP CODE
 LOCATE 5,30 : INPUT CITY\$
 END FUNCTION

IDENTIFICATION DIVISION.
 PROGRAM-ID.
 POPADDR.
 AUTHOR.
 JOHN.
 DATE-WRITTEN.
 JULY 15, 1992.
 DATA DIVISION.
 WORKING STORAGE S
 01 NAME
 PROCEDURE DIVISION.
 ADOO - SAY NAME
 DISPLAY 'N
 ACCEPT
 STOP R



Odyssee lets you avoid the punishment of programming development.



Creating applications doesn't have to hurt

The extraordinarily complex process of writing software applications is time-consuming and repetitive. And can get you into a lot of trouble.

If after months of writing in excess of thousands of lines of code a client decides to change the specs or platform, the punishing procedure begins all over again.

Introducing Odyssee from Case Design, a new concept in programming development soft-



Odyssee is innovative, flexible and portable

ware that eliminates the need for editors or a high degree of technical skill. Odyssee is a fully integrated tool that features DBMS support, WYSIWYG user interface design and reporting.

In the development cycle, you can access a wide variety of helpful features including a data dictionary, physical and logical independence, tasks, actions, events and expressions. Resulting applications can run on a variety of OS platforms



Call for a free demo disk and try it yourself

(DOS, WINDOWS, UNIX) with no change.

Creating the data structure and manipulating the database are features of Odyssee that are transparent to the developers. Odyssee can simultaneously access and simplify the use of many different DBMS, including XBASE, ORACLE, UNIFY, SYBASE and DB RAIMA.

Call Case Design to learn how truly edifying Odyssee can be.

ODYSSEE FEATURES & CAPABILITIES

- No code or editors needed.
- Totally menu-driven.
- Object-orientation.
- Hypertext technology included.
- Data and process independence.
- Powerful built-in data manipulation.
- No run-time fees.

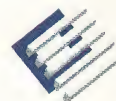
FREE INTRODUCTORY OFFER

Purchase Odyssee now and you'll receive a free introductory offer valued at \$400.

THE ODYSSEE STARTER KIT — \$1299

MS-DOS, XBASE for single user. Other platforms available. Call today for more details.

30-DAY MONEY-BACK GUARANTEE



CASE DESIGN
 RESULTS ORIENTED

CALL 1-800-880-1100

9111 Jollyville Road • Suite 207 • Austin, Texas 78759
 Phone (512) 346-8991 • Fax (512) 346-7920

Ad Code B1

STALKING THE ULTIMATE WORKSTATION

The BYTE Lab tests eight workstations with CAD and DTP applications

**BEN SMITH AND
RAYMOND GA CÔTÉ**

Taking all these factors into consideration, we arrived at some surprising results. If you're willing to look beyond the nameplate and put aside preconceptions about processors and operating systems, you may find yourself rewarded with good performance, reasonable cost, a system that's easy to work with, and a wealth of off-the-shelf applications.

To Begin With, a Definition

The term *workstation* has been applied to everything from Sparcstations to computer furniture, so, to begin, here's our definition: For us, a workstation is a computer designed for a single user, built for network integration, and equipped with high-resolution graphics and enough speed to handle demanding engineering and graphics tasks. Notice that we don't say anything about running Unix or about RISC architectures. If a DOS PC fits well into a network and makes a suitable host for CAD applications, we call it a workstation.

In this review, we've included four pure workstations: Sun Microsystems' Sparcstation2 GX, DEC's DECstation 5000/120, Hewlett-Packard's Apollo 9000 Model 710, and IBM's RISC System/6000 Powerstation/350. We also looked at two more personal workstations, Next's Nextstation and Silicon Graphics' Iris Indigo, which focus on blending the rich toolkit environment of Unix with desktop ease of use. And finally, we evaluated two not-so-humble personal computers, the Apple Mac Quadra 950 and the Compaq Deskpro 50M. Two notable platforms are not represented: Amigas and OS/2 systems. Commodore declined to participate in these applications, citing the Amiga's multimedia orientation; for the OS/2 story, see the text box "Where's OS/2?" on page 200.

This month, the BYTE Lab goes in search of the ultimate workstation. We put eight high-end machines through their paces. We tested performance on real applications, concentrating on CAD and DTP (desktop publishing). And we looked beyond the numbers to the element that most contributes to (or detracts from) productivity—the operating-system environment.



■ WHAT WORKSTATIONS ARE

They are fast, powerful, personal systems with high-end graphics hardware and network support. We measured these systems on their performance in CAD and DTP applications.

■ LIKES

The systems are fast and easy to use; they present consistent environments and offer broad software support for popular platforms.

■ DISLIKES

Some systems delivered surprisingly slow performance and had poor administrative tools.

■ RECOMMENDATIONS

The Mac Quadra 950 is the ultimate DTP machine. For CAD and raw high-end processing power, we recommend the IBM RS/6000 Powerstation/350.

Two Test Environments

There is no way to divorce an evaluation of these workstations from their underlying operating systems and the implementation of the applications software. We tested the systems on CAD and DTP, two of the most common workstation applications, which are demanding of graphics and floating-point hardware, as well as CPU speed. Besides performance, we evaluated features like ease of use and administration, which are critical in determining the most productive environment in which to work.

For our performance benchmarks, we ran tests using the same application on each system. The results appear in the benchmark figure, and the testing details are fully outlined in the text box "Modus Operandi" on page 198. Naturally, the quality of the software implementation varies from platform to platform, so the applications play a big part in determining performance. However, the whole environment—including applications software—will determine the performance that end users see, so that is what we timed.

We timed CAD operations with Autodesk's AutoCAD, and DTP jobs with Frame Technology's FrameMaker. Both are available on every platform we tested. However, we also ran Ashlar's Vellum 3D 2.12 on the Mac; Interleaf 5 on the DECstation, HP/Apollo 710, and Sparcstation2 GX; and Aldus PageMaker on the Mac and under Windows 3.1 on the Compaq Deskpro. Thus we got a feel for the breadth of applications available for each system.

continued

WORKSTATION FEATURES

Comparing features illustrates how broadly the term workstation can be applied. These systems present an eclectic mix of processors, processor speeds, and peripherals. Note that the prices for the configurations (CAD and DTP) we tested represent complete packages, including operating-system and applications software as well as hardware. (N/A = not applicable.)

	Apple Mac Quadra 950	Compaq Deskpro 50M	DECstation 5000/120	HP/Apollo Model 710	IBM RS/6000 Powerstation/350
Operating system	System 7.0.1	DOS 5.0/Windows 3.1	Ultrix 4.2	HP-UX 8.05/HP VUE 2.01	IBM AIX/6000 3.2
Configured prices					
Baseline tested ¹	\$9498	\$5319	\$9495	\$13,890	\$26,500
CAD configuration ³	\$17,196	\$12,163	\$12,995	\$17,390	\$36,260
DTP configuration ⁴	\$14,491	\$7013	\$10,980	\$15,385	\$30,790
COMMON CONFIGURATION INFORMATION					
CPU/memory system					
Processor	33-MHz Motorola 68040	50-MHz Intel 486DX2	20-MHz Mips R3000A	50-MHz PA-RISC	42-MHz IBM Power
Floating-point processor	Integrated	Integrated	Mips R3010A	Integrated	Integrated
Processor cache (KB)	8	256	128	32/64 ⁵	8/32 ⁵
RAM (MB)	12	8	16	32	32
Maximum RAM (MB)	64	64	120	64	128
Mass storage					
Hard drive size (MB)	400	510	330	420	800
Interface	SCSI	IDE	SCSI	SCSI	SCSI
Type	Internal	Internal	External	Internal	Internal
Other storage in tested configuration	SuperDrive floppy drive	1.44-MB floppy drive	CD-ROM, DEC Tape	1.44-MB floppy drive	150-MB QIC tape, 1.44-MB floppy drive
Networking/communications					
Network support	LocalTalk, AUI Ethernet	None	Thin-wire Ethernet	Thin-wire, AUI Ethernet	Thin-wire, AUI Ethernet
Serial ports	2	2	2	2	2
Parallel ports	0	1	0	1	1
Other ports	ADB, audio	Audio	None	Audio	Tablet, audio
Expansion					
Bus type	NuBus 90	EISA	TurboChannel	None	Micro Channel
Total expansion slots	5 NuBus 90, 1 PDS	5	3	None	4
Internal mass-storage bays	4	7	2	2	2
Service					
Warranty	1 year	1 year	1 year	90 days	1 year
On-site service	Option	1 year	1 year	90 days	Option
CAD CONFIGURATION					
Video controller					
Company	Radius ⁶	Matrox ⁶	DEC	Hewlett-Packard	IBM
Model	PrecisionColor 8X	MG-124/color upgrade	Included	Included	2770 Color Graphics Adapter
Price	\$899	\$1695	Included	Included	\$2310
Maximum resolution (pixels)	1152 x 882	1280 x 1024	1280 x 1024	1536 x 1024	1280 x 1024
Color depth	8-bit	8-bit	8-bit	8-bit	8-bit
Monitor					
Company	Radius ⁶	ViewSonic ⁶	DEC	Hewlett-Packard	IBM
Model	PrecisionColor Display/20s	ViewSonic 7	VRT 19	A1497A	6091
Price	\$3299	\$1399	Included	Included	\$3950
Maximum resolution (pixels)	1280 x 1024	1280 x 768	1280 x 1024	1024 x 768	1280 x 1024
Diagonal screen size (inches)	20	17	19	16	19
Tested software	AutoCAD 11, Vellum 3D 2.12	AutoCAD 12	AutoCAD 11	AutoCAD 11	AutoCAD 11
DTP CONFIGURATION					
Video controller					
Company	Radius ⁶	Compaq	DEC	Hewlett-Packard	IBM
Model	PrecisionColor 8X	QVision 1024/E	Included	Included	2760 Gray-Scale Adapter
Price	\$899	Included	Included	Included	\$1450
Maximum resolution (pixels)	1152 x 882	1024 x 768	1280 x 1024	1536 x 1024	1280 x 1024
Color depth	8-bit	8-bit	8-bit	8-bit	4-bit
Monitor					
Company	Radius ⁶	Compaq	DEC	Hewlett-Packard	IBM
Model	PrecisionColor Display/20	QVision 150	VRT 19	A1497A	8508
Price	\$3299	\$899	Included	Included	\$1345
Maximum resolution (pixels)	1280 x 1024	1024 x 768	1280 x 1024	1024 x 768	1280 x 1024
Diagonal screen size (inches)	20	15	19	16	19
Tested software	FrameMaker for Macintosh 3.0, Aldus PageMaker 4.2	FrameMaker for Windows 3.0, Aldus PageMaker 4.0	FrameMaker DECX 3.1, Interleaf 5	FrameMaker HPLX 3.1A, Interleaf 5	FrameMaker IBMX 3.1A

¹ As-tested price is for configuration listed below, plus keyboard, mouse, OS, and documentation. It includes monitor and graphics adapter only if they are listed below as "Included."

² System evaluated included a 400-MB drive, nonstandard on the Nextstation. Pricing is for the standard configuration, which includes a 105-MB drive.

³ The CAD configuration includes baseline features plus CAD graphics features and AutoCAD.

⁴ The DTP configuration includes baseline features plus DTP graphics features and FrameMaker.

WORKSTATION FEATURES

Next Nextstation	Silicon Graphics Iris Indigo	Sun Microsystems Sparcstation2 GX
NextStep 2.1	IRIX 4.0.1	SunOS 4.1.2/OpenWindows 3
\$4995 ² Not tested \$5790 ²	\$12,995 \$16,495 \$14,490	\$22,190 \$25,940 \$23,685
25-MHz Motorola 68040 Integrated 8 8 32	33-MHz Mips R3000A Mips R3010A 32/32 ⁵ 16 96	40-MHz SPARC Integrated 64 32 128
105 SCSI Internal 2.88-MB floppy drive	236 SCSI Internal 1.3-GB DAT	424 SCSI Internal 1.3-GB external HD, 150-MB QIC tape, CD-ROM drive, 1.44-MB floppy drive
Thin-wire, 10Base-T Ethernet 2 0 DSP, printer	AUI Ethernet 2 1 Audio	AUI Ethernet 2 0 None
None None 2	GIO32 2 3	SBus 3 2
1 year Option	90 days 90 days	90 days Option
Not tested N/A N/A N/A N/A	Silicon Graphics Entry Graphics Included 1024 x 768 8-bit	Sun Microsystems GX Included 1152 x 900 8-bit
N/A N/A N/A N/A N/A	Silicon Graphics GDM-1630SG Included 1280 x 1024 16	Sun Microsystems 19-inch color Included 1152 x 900 19
N/A	AutoCAD 11	AutoCAD 12
Next Included Included 1120 x 832 2-bit	Silicon Graphics Entry Graphics Included 1024 x 768 8-bit	Sun Microsystems GX Included 1152 x 900 8-bit
Next MegaPixel Display Included 1120 x 832 17	Silicon Graphics GDM-1630SG Included 1280 x 1024 16	Sun Microsystems 19-inch color Included 1152 x 900 19
FrameMaker for Next 2.0D	FrameMaker IABI 3.0	FrameMaker SUNX 3.1A, Interleaf 5

⁵ Instruction cache/data cache.

⁶ System also includes built-in video as part of common configuration; we tested with these additional products for greater resolution and/or monitor size.

THE ULTIMATE WORKSTATION

Common Factors

Whether you intend to set up a group of workstations for CAD, DTP, or some other application, you should consider some factors beyond the desired application. Chief among them is the availability of commercial applications software for the platform you choose. Although applications such as AutoCAD and FrameMaker are available on a wide variety of platforms, they are not necessarily the best applications to solve your problems. In many cases, you'll end up selecting applications from the same companies that provide the hardware. HP, for example, which is well known for engineering applications, offers a wide variety of software support that is tightly coupled to its own hardware.

Another consideration is your current environment. If you are already a Unix shop, you've invested in the steep learning curve associated with the operating system, and scrapping it for better applications support is probably a bad option. Keeping Unix and adding a modern windowing interface may be a suitable answer. Remember that windowing systems add a lot of overhead to your system and that the applications you are using must support the windowing system as well as the operating system.

But don't let an installed base keep you from adding a little variation to your environment. The name of the game today is compatibility. Unix workstations have always communicated well, and now PCs and Macs are joining the chorus. Silicon Graphics is making the added effort to ensure that its Iris Indigo systems blend in well with Macs by supporting Apple file-sharing protocols and a wide variety of data formats. Even a moderate-size network can take advantage of a mix of desktop personal computers linked through Unix workstations or communicating with minicomputers and mainframes.

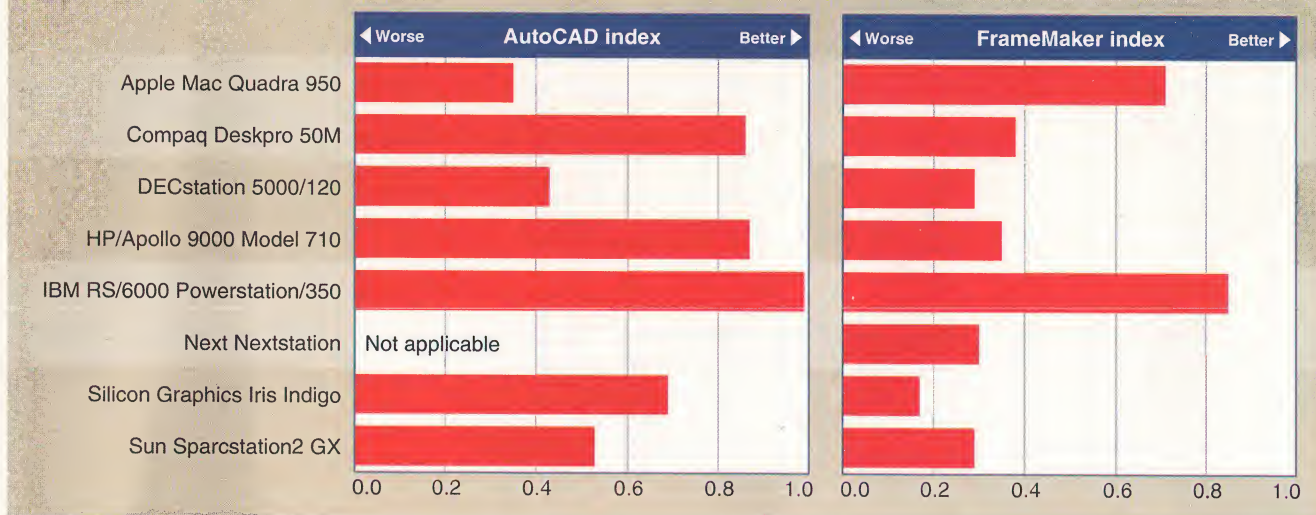
Finally, don't forget the system administrator. Ease of setup and installation and the sophistication of management tools should play a part in your decision.

To identify our ultimate workstation, we spent quite a bit of time setting up these systems, performing some basic system maintenance, linking each workstation into the network, and using the system-supplied applications and tools. Of course, we also ran the benchmark applications and other applications, as noted above.

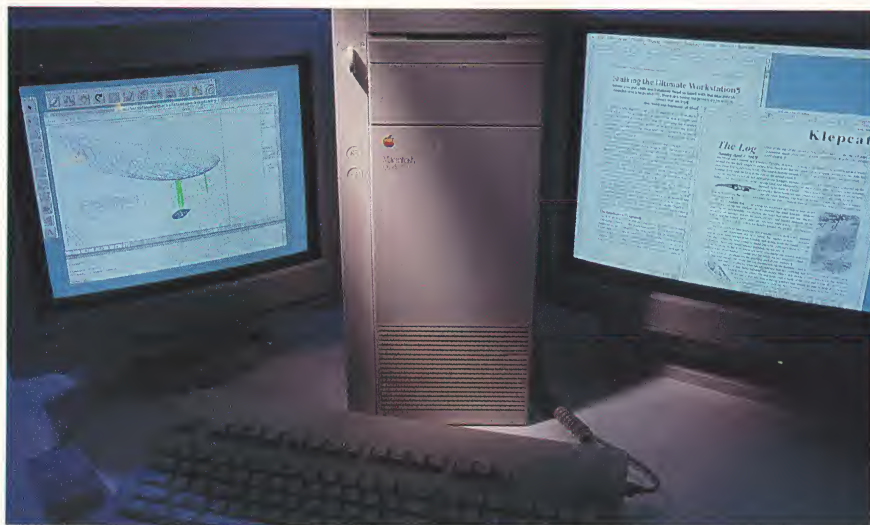
Our evaluations follow. In each case, we balanced the application timing results with our feel for the environment the system provides, and the type, breadth, and scope of applications available. The table gives configuration details for each workstation.

continued

APPLICATION BENCHMARKS



Performance tests show that the 42-MHz IBM Powerstation/350 outruns the other systems in both CAD and DTP tasks. These indexes represent the relative speed of each workstation running a suite of operations in AutoCAD and FrameMaker; different application packages may produce different results.



Apple Mac Quadra 950

In our opinion, a major attribute of the Quadra 950 is simplicity. It's simple to install, simple to administer, and simple to use. For example, it took us a mere 10 minutes to add a second monitor to the system and only 2 minutes to connect the system to the network. Once connected, the extra monitor was immediately recognized by all our test applications without our lifting a finger. This level of attention to detail is what makes the Quadra a joy to use (see "Racing at 33 MHz: Quadra 950

and Radius Rocket 33," October BYTE).

When we started this review, we were prepared for the Quadra to fare poorly. After all, it's only a personal computer up against some of the most powerful RISC-based workstations on the planet. However, experience proved otherwise. The speed of its 33-MHz 68040 and the elegance of System 7.0.1 created an unbeatable combination.

In head-to-head competition in the DTP arena, the Quadra 950 excels in its user interface and holds its own in speed (see the benchmark figure). Not so surprising, the Quadra 950 also beats most of the other workstations on price, coming in at

\$14,491 for a full DTP configuration, including a 20-inch Radius monitor and a Radius PrecisionColor 8X display adapter. The added screen real estate helped to make the Quadra 950 an outstanding DTP system.

We used the Quadra 950 to produce the bulk of our sample document. FrameMaker proved to be well adapted to Mac user-interface conventions, as did PageMaker. We quickly and easily exchanged data among multiple text editors, image scanners, and photo touch-up software, and between networked applications on multiple machines. None of the other workstations provided such a tightly integrated environment.

However, some cracks did show around the edges. For example, although PageMaker 4.2 ran properly on a second monitor, it insisted on moving the active window to the primary monitor whenever the window was zoomed.

The Quadra 950 did not fare as well on the CAD testing. Again, price was very good (\$17,196), but, as the benchmarks show, AutoCAD performed poorly on the Quadra. Vellum 3D 2.12 ran most of our tests close to twice as fast, but even with this advantage the Quadra wasn't able to compete with the other workstations.

Also, there simply isn't the variety of engineering applications for the Mac that there is for other platforms. Apple is consciously targeting this area for improvement, but today this is a weak spot for the Quadra. However, Vellum 3D is an

A chain is as strong as it's weakest link.

Picture your Hardlock™ key as a bike lock, and the accompanying software routines used to implement the copy protection as the chain. You can own the best lock that money can buy, but that lock is useless if the chain is weak.

Introducing **HL-CRYPT**, a major breakthrough in copy protection. HL-CRYPT is not just a shell or simple conditional response checker. Using our proprietary Patcher Technology, HL-CRYPT is a one path security compiler protection linker that encrypts and binds the application to your Hardlock™ device. HL-CRYPT features an end-user selectable modular protection technique that secures the application against piracy, reverse engineering, debugging, and more.

Picture HL-CRYPT as an ironclad chain. The only ironclad chain in the industry today. For more information, call

1-800-562-2543

HL-Crypt

**The Fortified Protection Linker
for Hardlock**



SHOWN
ACTUAL
SIZE



The only product that combines fortified software encryption with the Hardlock™ family of copy protection devices for single user, network and work station implementation.

GLENCO ENGINEERING INC.

SERVING THE SOFTWARE INDUSTRY SINCE 1979

270 Lexington Drive
Buffalo Grove, IL 60089-6930
Phone 1-800-562-2543
Fax 708/808-0313

For a distributor in Europe contact Fast Electronic GmbH, Tel: 49-89-538-800-0 Fax: 49-89-539-800-40
In Korea contact Finecom, Tel: 82-2-690-5811 Fax: 82-2-605-5729 • In Brazil contact HT-MACH, Tel: 21-257-0314 Fax: 21-235-6808
In Chile contact Datasoft S.A., Tel: 562-246-7443 Fax: 562-208-0591 • In Peru contact V.C.H.I., Tel: 51-14-440537 Fax: 51-14-475984

For International information circle 129, For End-User information circle 130 on Inquiry Card.

Modus Operandi

We benchmarked system performance on CAD and DTP (desktop publishing) jobs using two popular commercial applications, AutoCAD and FrameMaker. Although these two products are not the most popular programs in every environment, they are available—and among the leaders—on every platform we tested.

The benchmark figure shows the results of these tests. Each bar is a composite score based on timing a series of operations. For each operation, the fastest machine scores 1, and the other systems receive fractional scores based

on their relative performance. The bar in the figure represents the average of these scores.

Designed to Sail

Our data file for AutoCAD performance tests was a 3-D hull and keel design for an America's Cup-class racing sailboat. Pedrick Yacht Designs of Newport, Rhode Island (designer of the *Stars and Stripes*), provided us with the test file. The AutoCAD drawing contains 327 polylines, each averaging about 450 vertices (roughly 150,000 points in 3-D space) split into eight drawing layers. We timed four tasks:

loading the file from disk and generating the drawing, regen, redraw, and a 30-degree rotation of the entire hull in user-coordinate space.

We measured system speed for DTP by timing three tasks with FrameMaker. First, we opened a 100-page formatted document that included four EPS (Encapsulated PostScript) bit maps (i.e., 180-KB, 5-MB, 1-MB, and 150-KB images). Then we measured the time it took to reformat the body of the text after changing the default font from 10- to 12-point type. Finally, we timed an import of 100 pages of raw ASCII text and the 5-MB image.

excellent CAD package that does run on the Mac. We discovered that Vellum 3D is among the easiest CAD packages to learn and use on any platform.

But the Quadra's real strength is its environment. It provides fully integrated support for text, graphics, sound, images, and video. Network support is simple and solid. Connecting to network printers, fax servers, and modem servers is a simple matter of selecting the appropriate item once, within the Chooser. When a new printer is added to the network, the administrator does not need to inform everyone of the new service—it just appears. You can mount folders on remote machines by setting a sharing option available through the main menu system. And standard methods for accessing SCSI hardware frees users from worrying about driver conflicts between SCSI devices.

The Mac Quadra 950 also represents a marked advance in Apple networking. The Quadra has an integrated EtherTalk port for direct connection to high-speed Ethernet networks. This is a dramatic improvement over the relatively slow LocalTalk.

With the exception of engineering software, the number and quality of applications available for the Quadra are outstanding. By developing and promoting an evolving set of interface standards, Apple has helped to establish consistent interface methods that ensure you'll be comfortable using applications for the first time. Applications that are inconsistent with these guidelines without good reason

simply don't last long. Finally, unlike owners of Windows PCs or users of Unix workstations with graphical shells, Mac users don't need to live in two worlds, balancing their time between graphical and command-line interfaces.



Compaq Deskpro 50M

If you need to run one application, run it very quickly, and do little else, then a PC running DOS is nearly unbeatable. PCs have several advantages: The hardware is well standardized, there are lots of speed-increasing add-on peripherals (e.g., the vector-based Matrox MG-124 video card we used for AutoCAD testing), and the small operating system allows your application to have almost complete control of the hardware. When an application runs

on a PC, it receives nearly 100 percent of the available processor time.

Our AutoCAD benchmark shows that the Deskpro 50M held its own against most of the workstations. The reason is twofold. First, the Matrox video card provided display-list processing with drivers tuned specifically for AutoCAD. Second, since DOS is a single-tasking operating system, AutoCAD did not need to contend with the overhead of a Unix installation.

AutoCAD looks the same no matter which system it runs on. This is annoying at best on graphical platforms, which have their own ideas of what a windowed application should provide, but AutoCAD is right at home on the Deskpro 50M. As the best environment for the world's most popular CAD package, the Deskpro certainly earns a few points.

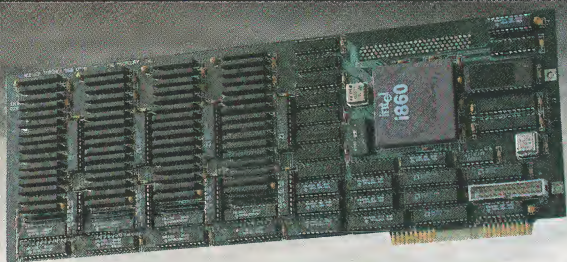
Adding a second high-resolution monitor for the AutoCAD benchmark was straightforward. The MG-124 video card worked straight out of the box; we just added an AutoCAD driver. Installing the 17-inch ViewSonic 7 monitor was a matter of connecting a few cables, and it provided an excellent display. Unlike the Mac environment, however, the operating system itself (DOS and Windows) doesn't recognize the second monitor.

Including AutoCAD and the optional video hardware, the Deskpro came in at \$12,163, making it the least expensive CAD platform by far. Furthermore, even using standard Qvision video and a Compaq monitor, the Deskpro came in second to the Nextstation as the least expensive

486-B²T

486/860 Speed... Microway Quality.

Microway has engineered four distinctive black tower systems. The **486-B²T** is designed for high-end users. It comes standard with American 486 motherboards and power supplies, yet has a reasonable starting price of \$2,195. A broad range of options can be installed including high speed and capacity hard disks, intelligent serial controllers, tape back-up units, high end graphics adapters and our *Number Smasher-860*. These systems are ideal for configuring Novell or UNIX file servers, multiuser systems, and workstations for graphics, CAD and scientific uses. The **486-B²T** comes with dual fans, *Across the Board*™ Cooling and American industrial grade power supplies. All systems are thoroughly tested, burned in and include the best technical support in the industry, which we've provided since 1982.



Number Smasher-860

The key to attaining workstation performance is Microway's 40MHz *Number Smasher-860*. It features a four-way interleaved 64-bit memory system that runs at 160 megabytes/sec. The *Number Smasher's* i860 has been clocked at 80 megaflops doing matrix multiplies, 67 megaflops doing FFTs and 11.8 Double Precision Linpack Megaflops on large arrays—ten times the speed of a 486 and twice the speed of a Cray 1F! One happy user recently reported that his "Baby Cray" was happily humming away saving him thousands of dollars per month in 3090 rentals. The *Number Smasher* comes with the finest i860 compilers on the market, your choice of Microway's NDP™ FORTRAN, C/C++ or Pascal.

Call or write today for more information on Microway's new black tower systems.



The Intel Inside Logo is a trademark of Intel Corporation.

Technology You Can Count On

Microway®

Corporate Headquarters, Box 79, Kingston, MA 02364 USA • TEL 508-746-7341 • FAX 508-746-4678 • U.K./Europe 081-541-5466
France 01 43 2 69593 • Germany 069-75-2023 • Holland 40 836455 • Italy 02-74.90.749 • Japan 0474 23 1322 • Norway 6-892020

DTP platform (\$7013).

DTP on the PC has come a long way with the popularity of Windows. The Deskpro 50M finished a respectable third on our DTP timings. FrameMaker for Windows and PageMaker both take good advantage of the Windows interface. DTP typically requires multiple applications cooperating on a single document. For example, our test document consists of text that originated from a word processor, combined with scanned images and clip art. True multitasking may not be required, but cooperative multitasking greatly simplifies the task.

The user environment on the Deskpro 50M, typical for DOS/Windows PCs, still leaves a lot to be desired. Many of today's PC users find themselves time-sharing between DOS and Windows. Unfortunately, the boundary between these two environments is rather fuzzy. Windows users still have to resort to the DOS command line to perform most maintenance and administrative jobs.

DOS has two rather serious difficulties. First, you must continually worry about the amount of available memory being used in the first megabyte of address space. Even with DOS-extender-based applications such as AutoCAD, which take full advantage of system memory, you still need to worry about how much space is being consumed by network and peripheral drivers.

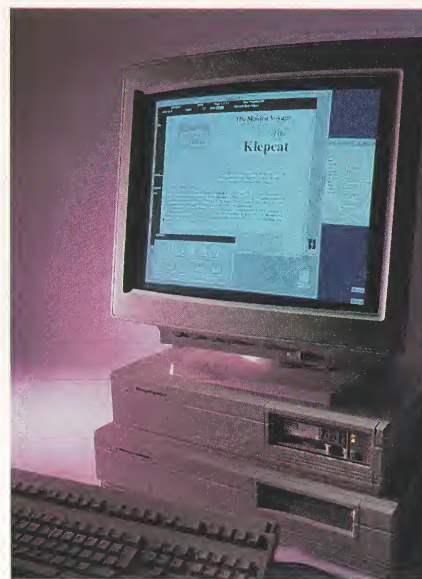
Second, multitasking DOS applications is a risky proposition. Windows and environments like Desqview have made

multitasking possible, but these environments are incredibly complex and hardly stable. Windows' greatest difficulty is its tendency to crash, leaving behind only a cryptic message or sometimes just leaving you staring at the DOS command line with no indication of what went wrong. Although the Deskpro was not by any means the only system we crashed during this review, it seemed the easiest to break while running Windows.

Even though Windows has been around for several years, it still struggles through its infancy. System administration remains difficult, with many administration functions needing to take place in DOS before Windows is run. Windows' dual requirements of compatibility with DOS applications and having to run on a broad range of nearly compatible platforms have also given rise to a set of arcane initialization files that have to be tuned for each environment.

In all fairness, most of these difficulties are the result of Windows' need to remain backward-compatible with DOS applications. Windows was neither a ground-up original work (like the Mac operating system) nor an overlaid interface (like any of the X Window System-based Unix GUIs).

Although it lacks a pleasant working environment, the Deskpro 50M is an inexpensive, fast performer on single applications. In summary, if you have a very focused, single-application environment, a DOS platform like the Deskpro 50M is an excellent choice.



DECstation 5000/120

Until recently, DEC has demonstrated a lack of commitment to advanced development for Ultrix, its BSD-based version of Unix. The DECstation line still seems to be an Ultrix adjunct to DEC's extensive VAX/VMS offerings. When they first came to market, DEC's R3000-based DECstations were performance leaders, but they have been losing ground ever since. Given this history, it's not surprising that the DECstation lacks the dazzle of other workstations.

We configured the DECstation identically for CAD and DTP; the price difference (\$12,995 for CAD, \$10,980 for DTP) represents differences in AutoCAD and FrameMaker licenses only. The DECstation 5000/120 came in second to last in both application tests. The lack of speed comes not only from its 20-MHz processor; the system's hard drive was the slowest of any of the systems we evaluated.

In addition to running AutoCAD and FrameMaker, we spent a great deal of time with Interleaf 5, a very popular DTP system on the DECstation, Sparcstation, and other Unix platforms. We found that Interleaf, like AutoCAD, has a very demanding interface that's inconsistent with the system's resident GUI. Like AutoCAD, Interleaf 5 is a windowing application within a windowing environment.

The DECstation 5000/120 requires two separate boxes: a CPU box (with a CD-ROM drive) and an expansion chassis. The tape format is the proprietary single-spool DEC tape cartridge.

Like all DEC equipment, the DECstation 5000/120 is reliable and predictable—

Where's OS/2?

Although it is not discussed in this article, we also reviewed an IBM PS/2 Model 90 XP 486 as part of our quest for the ultimate workstation. The Model 90, running OS/2 2.0, was a fast, stable platform. At \$10,150, including a monitor, it's definitely a strong contender on the price/performance front.

Unfortunately, we found a dearth of commercial OS/2 CAD and DTP (desktop publishing) applications. The major software vendors either don't support the platform at all (e.g., Frame Technology and Interleaf) or offer only outdated versions (e.g., Aldus and Au-

todesk). The only major DTP player that is now actively supporting OS/2 applications is Ventura Software, which offers Ventura Publisher for OS/2.

OS/2 is a very strong player in the financial and general-business arenas, with outstanding client-server database support and excellent support for other server products like Lotus Notes and Imara. But although some publishers have announced plans to deliver engineering and graphics applications for OS/2 2.0, it's currently not much of a contender for traditional, single-user workstation tasks.

To run X on your PC, you'll have to master this extremely complex operating procedure.

"Click."

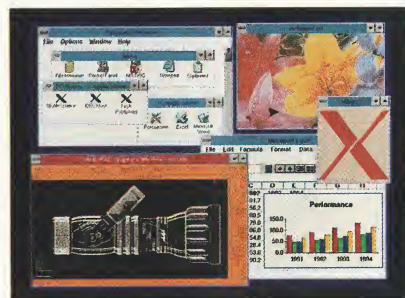
Running X on your PC couldn't be simpler. With PC-Xview for Windows, all you do is point and click. There's the X application, from across the network, in its own window on your PC. Now cut, paste, and move information between X and Microsoft Windows,TM just as you're used to doing.

Or if you work on a DOS-based PC, just add PC-Xview for DOS to access graphics-based X applications.

And when work takes you on the road, take our PC-Xremote option to access the X environment over a modem. So critical applications are always at your fingertips, no matter where you are.

With products like these and proven customer support, NCD makes accessing X applications as easy and convenient as using a PC.

So for more information about how PC-Xview will get your PCs and X to really click, simply call: 1(800) 793-7638.



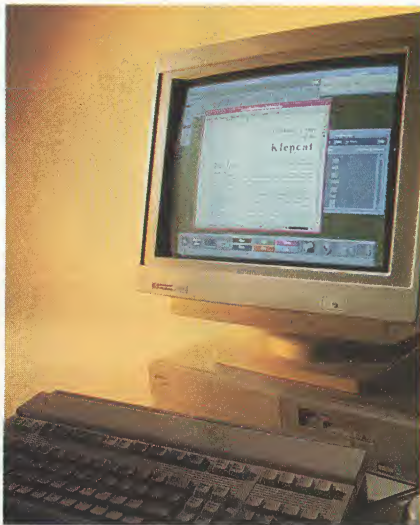
Network Computing Devices, Inc.

All registered and unregistered trademarks mentioned above are the sole property of their respective owners.

NCD
PC-Xdivision

even simple. Software installation went without a hitch. DEC was instrumental in the development of X and Motif, so its implementation of the user interface is excellent. Each user's session is controlled by a session manager, a special console window from which you launch application programs and receive messages from the system. The User Executive (i.e., file manager) is character-based and simple to understand and configure. As a rule, the system software extensions are designed so that they work as well in an X window as on a character terminal. Our only complaint is that the default icons (for scrolling the window and launching programs) are very small and require fine dexterity. There are no other frills to the GUI.

The clumsiest elements of the DECstation are the keyboard and mouse. The keyboard has no Escape key (you have to map it to another key for each program). The mouse is circular, like a hockey puck, which means that you have no automatic registration between your hand and the mouse buttons when you grab it. Despite the raised pattern on two of the mouse buttons, it's easy to press the wrong button. The mouse is light, is easy to move accidentally, and lacks feedback. The keyboard and mouse complaints may sound trivial, but these input devices are the human interface for the workstation, and it's important that they be comfortable.



HP/Apollo Model 710

The Hewlett-Packard/Apollo 9000 Series 700 workstations have the reputation for being the fastest in their price range (see "A New Workstation Standard," June 1991 BYTE, page 52). Surprisingly, the Model 710 did not perform very well on

the DTP application benchmarks despite its prowess on our low-level tests. This discrepancy underscores the importance of the application you choose in determining system performance.

As with the DECstation, we ran the Model 710 with the same configuration (16-inch color graphics) for both DTP and CAD tests. With AutoCAD, the Model 710 sells for \$17,390; with FrameMaker, it sells for \$15,385. These prices put it generally on a par with the Quadra 950.

If engineering is your field, you may already be sold on the HP/Apollo workstation; Hewlett-Packard is a very popular name in engineering. Along with this reputation come many fine engineering applications (including CAD) that may not exist on other platforms. This alone is reason enough to put an HP/Apollo workstation on your list of preferred systems.

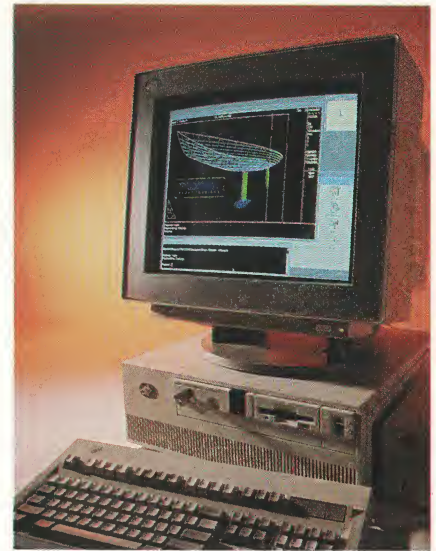
The 710 performed well on our CAD tests, scoring second only to the IBM Powerstation/350. However, its DTP score placed it a disappointing fourth, behind even the Deskpro 50M. As with the DECstation, Interleaf is the better-known DTP package for the 710. However, with the advance of Motif and X on HP workstations, we expect that FrameMaker will supplant Interleaf, especially if Frame Technology polishes it up for this platform.

The 710 is a classy workstation. You can replace the internal floppy drive with an optional DAT (digital audiotape) drive. Its internal disk storage space is sufficient for a stand-alone workstation.

HP's VUE (Visual User Environment) is the most elegant Unix interface. An X- and Motif-based window manager, VUE lets you have several different workspaces, each with its own collection of windows and applications. You toggle between workspaces via the screen button (an icon, of sorts) that represents that workspace. When you end a session, you can save information about what applications are running and where their windows are located so that when you start a new session, VUE puts you back where you left off.

Besides VUE, HP provides a simple but useful icon-based file manager. However, in no way does it rival the file-handling systems of the Mac or Iris Indigo. System administration is simplified thanks to HP's SAM (System Administration Menu) and special features of HP/UX.

HP has maintained a consistency over the years in its keyboard and terminal-screen layouts. This has led to some problems, particularly with HP's DOS systems, where they've conflicted with the designs of PC compatibles. However, HP's terminal design works well for Unix. Keyboards are more compact and take up less space.



IBM RS/6000 Powerstation/350

There is little question that IBM's RISC System/6000 Powerstation/350 is a robust and well-engineered machine. The monitor is crisp; the display is snappy. In performance, the Powerstation was undisputed champ, handily taking first place on CAD and DTP applications tests.

On the negative side, the 42-MHz RISC System/6000 system is much more expensive than most of its competition. We tested a color Powerstation for CAD (\$36,260) and a monochrome system for DTP (\$30,790). The 19-inch displays are gorgeous, and the system runs like a thoroughbred, but the prices are well beyond those of the other systems in this review.

Also, AIX is far from easy to become used to, particularly if you have worked with more standard versions of Unix. The default user interface is merely the character-based screen, not Motif/X. The GUI is there, but the administrator must install it as the default log-in interface. IBM is lagging behind the other workstation manufacturers in its development for OSF/Motif, even though it was one of the original members of OSF (Open Software Foundation). Although its Power Desktop icon-based file and application control looks as though it might develop into something very attractive, the window manager and file manager still have a long way to go.

However, AIX is not only different from other versions of Unix, it's also very sophisticated. It has unique features like the virtual volume manager, which lets you modify the size of disk partitions without going into single-user administrative mode.

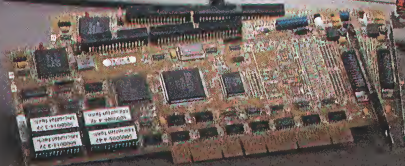
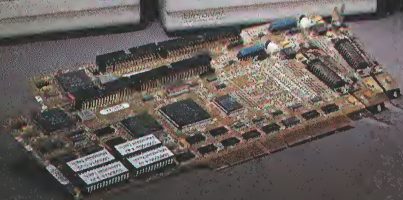
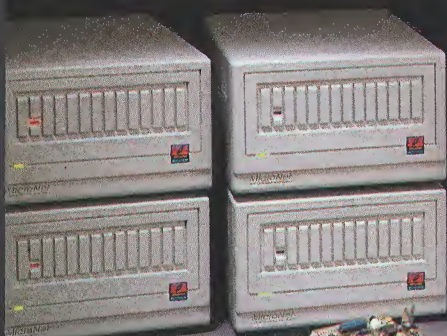
continued

Performance *Plus* Protection

 **Seagate**

Spanned For Performance

Mirrored For Protection



Fast SCSI-2 BusMastering Host Adapters



Fault-Tolerant File Servers, Fast as 5.5 ms

Today's network managers face more mission-critical data residing on individual servers. MicroNet knows you need cost-effective storage solutions offering the ultimate in performance *plus* protection.

We've engineered our storage systems, featuring Seagate high performance drives, to optimize the built-in features of NetWare. By spanning multiple Elite-2 hard disc drives, and multiple host adapters, access times drop as low as 5.5 ms and sustained data transfers climb to an astonishing 12 MB/sec.

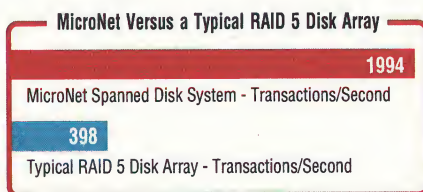
But there is another side to the story. Your data needs protection. If a server goes down, rapid data recovery is essential. Mirroring the hard disc system creates an on-line duplicate of the data, should

anything go wrong with the primary drive. If a fault occurs with the CPU, the complete drive chain can be moved to an ISA, EISA, or MCA workstation using a MicroNet host adapter to create an instant file server!

MicroNet systems offer full protection all the way

to the controller card level. Our NetWare device drivers allow a disc drive to be changed on-the-fly. And we offer these features without being locked into a proprietary software or hardware system.

Protection while minimizing down-time is one side of the story. Productivity is the other. By utilizing a MicroNet high performance storage solution, you get performance *plus* protection. Call MicroNet today for more information. 1-714-581-1540.



Performance *Plus* Protection, Without Compromise.

MicroNet Technology, Inc.

20 MASON • IRVINE, CA 92718 • TEL: (714) 837-6033 • FAX: (714) 837-1164
AppleLink: MICRONET.SLS • Compuserve: 76004,1611

Seagate and the Seagate logo are registered trademarks, and Elite is a trademark of Seagate Technology, Inc. All other trademarks are property of their respective owners.

Circle 150 on Inquiry Card (RESELLERS: 151).



With this feature, you can even change the size of a file system on the fly.

IBM also offers a system-administration tool called SMIT (System Management Interface Tool). SMIT is a hierarchical tree of menus for configuring and controlling the operating system and installing hardware. Admittedly, learning SMIT is far simpler than learning the esoterica of Unix system administration through editing the dozens of syntactically divergent tables that underlie any Unix system. But SMIT and AIX are so unlike any other Unix variation that a system administrator seasoned on a more conventional system will agonize over learning entirely new procedures. Despite IBM's creation of a better Unix than that delivered by Unix Systems Lab (or even OSF), it's unlikely that the rest of the world will follow IBM's lead.

We had more difficulty installing the software on the Powerstation than we did on any other system. SMIT is not idiot-proof—we corrupted the boot file system by improperly attempting to enlarge another file system. Once we rebuilt the disk and operating system, we still had problems installing FrameMaker. Even the common Unix commands that are part of the installation have uncommon options and actions. IBM can be commended for its work in trying to improve Unix, but there is something to be said for going along with industry standards.



Next Nextstation

The Nextstation is a marriage of Unix capability and well-designed graphical-interface flexibility. Although out of the running for CAD (there simply isn't much

support), the Nextstation offers a wonderful DTP environment. Unfortunately, the Nextstation is one of the great undiscovered machines. Although it's advertised and discussed widely, it has yet to attract the hordes of developers and software publishers who will bring their multiplatform applications with them. The problem for Next continues to be market share.

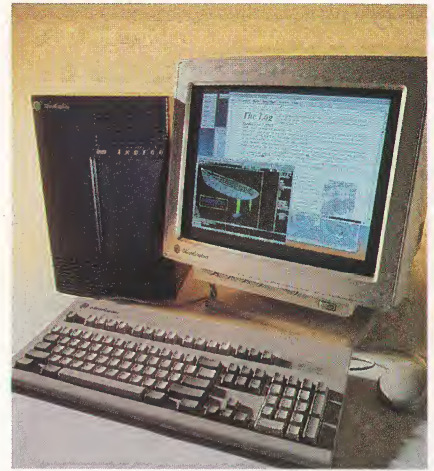
We tested the entry-level Nextstation. At \$4995 (\$5790 with a FrameMaker license), it's the least expensive machine we tested. Our test Nextstation also included a nonstandard 400-MB hard drive instead of the standard 105-MB model. We've listed pricing for the standard system because configuring the Nextstation the way we tested it (as a custom package) would cost almost as much as buying a 33-MHz Nextstation Turbo with the 400-MB drive built in. The 25-MHz Nextstation ran through the DTP benchmarks at speeds comparable to those of the 20-MHz DECstation 5000/120—an acceptable performance but generally behind the pack.

The Nextstation's limited display can show only four shades of gray. High-color images (e.g., the scanned map on our DTP test) display as slightly grainy. This limited pixel depth doesn't present any great difficulties for page layout, where the positioning of images is the major concern, but it does present problems for any image-processing applications.

Next provides a tightly integrated graphical interface. Unlike other Unix implementations, the Nextstation keeps you within the graphical environment at all times, unless you specifically ask for a command line. Even the most complex program development and system-administration processes can be completed without leaving the graphical shell. The ability to perform all tasks, including system administration, from the graphical environment approaches the Macintosh's and far exceeds Windows' ability on the PC.

The Nextstation excels in its powerful, object-based development and user environment, NextStep. NextStep and Interface Builder provide a leading-edge visual environment that insulates programmers from the command-line operating system. Even on the Mac, the standard development environment reverts to a command-line interface.

While this system is extremely useful in a corporate environment where custom applications will be developed, it provides little advantage in mixed-platform or stand-alone environments. A lack of standard software support is the main reason the NextStation does not make our top-three list.



Silicon Graphics Iris Indigo

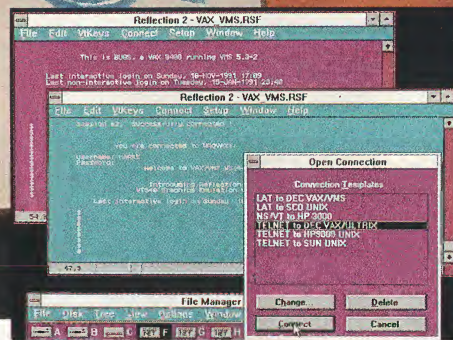
One of us has had an Iris Indigo on his desk for many months, choosing it over a number of other workstations. Its user interface makes it a very comfortable system, and we found day-to-day performance to be adequate. But quantitative benchmarks are another matter: The Indigo came in dead last on our DTP tests and placed only fourth among CAD systems.

Nevertheless, the Indigo presents an outstanding user environment and an attractive price. At \$16,495 for the system plus AutoCAD and \$14,490 for the system plus FrameMaker (including an optional DAT drive), the Indigo is one of the least expensive workstations we tested.

Unlike most other Unix workstations, the Indigo case is a mini-tower that can sit in the back corner of a desk or on a bookshelf. You can upgrade hardware and install peripherals without tools. The keyboard is laid out like PC keyboards, and the mouse can plug into the right or left side, as it can on a Mac.

Of all the Unix workstation environments, the Indigo is unquestionably the nicest for casual users. But it still has all the tools that experienced technical users and system administrators want.

Silicon Graphics' Workspace GUI doesn't have multiple workspaces, like HP's VUE, but the Workspace file manager rivals even that of the Macintosh. It can determine a file type using a rule set that includes information on permissions, filename, and data within a file. This makes it possible to define actions that are appropriate for any number of different files. The files appear as icons corresponding to applications. Double-clicking on a file brings up the application—just as on a Mac. You can also drag and drop



Reflection: your passport to multivendor connectivity.

The computing world is changing. Now, Reflection® and the Reflection Network Series® software extend the reach of your desktop computers in multivendor environments.

Together, Reflection and the Reflection Network Series link all your systems. Reflection provides the user interface, offering the most precise VT and HP text and graphics terminal emulators for DOS, Macintosh, and MS-Windows. Reflection also delivers fast file transfer, keyboard mapping, and a powerful command language to automate the most complex tasks.

Using Reflection with the Reflection Network Series lets you work on host and server applications at the same time. Access is provided to Digital VAX, UNIX, HP, and IBM hosts, *concurrently*, along with Novell and other LANs. You can run multiple protocols simultaneously on a single PC, and switch among them without rebooting. Because protocols are loaded only as needed, memory is saved as well. It's the software solution that operates without a lot of additional hardware.

Reflection and the Reflection Network Series—the connectivity choices for a changing world.

ADE/F	(61) 73 32 49
Wick Hill IMX Ltd./GB	(0483) 772280
GFK Hamburg/D	(040) 23 73010
Salcom/SF	(90) 804 1789
Computing & Systems Consultants/NL	(040) 434 957
SIS Datenverarbeitung/A	(1) 376316
Sosistem/I	(030) 2421074
Silicon/P	(1) 8151234
Scorpion Systems/E	(93) 485 40 44
Nocom AB/S	(018) 32 1090
Nocom Norge AS/N	(034) 70494
Bodeind/S	(1) 612061
CommCare/CH	(01) 730 24 31
Megatec/AUS	(3) 874 3633
Brazil Software/BRA	(21) 240 3143
One to Seven Products/NZ	(9) 3580758
Singapore Computer Systems Pte. Ltd./SIN	441 2688
A-Line Technologies/B	(02) 718 3611
Tempest Europe/DK	(44) 94 89 02
Cybernet Systems/JPN	(03) 3982 3701

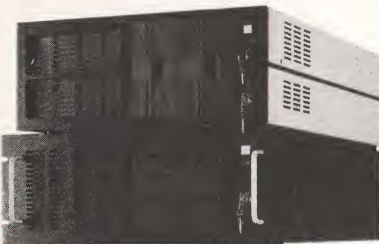
REFLECTION
SERIES
SOFTWARE

Walker Richer & Quinn, Inc.

Rack & Desk Chassis

FOR IBM XT/AT/286/386/486

Integrand's unique packaging design uses modular construction. We have 3 basic models for ISA/EISA bus computers. Over 90 interchangeable modules allow you to customize them to nearly any requirement. We make drive enclosures and rackmount keyboards too. Integrand offers high quality, advanced design hardware and strong support. Why settle for less?



Rack & Desk Models

Accepts Most Motherboards and Passive Backplanes

Doesn't Look Like IBM

Rugged, Modular Construction

Excellent Air Flow & Cooling

Designed to meet FCC

204 Watt Supply, UL Recognized

200 & 300 Watt Supplies, UL, CSA, TUV

Reasonably Priced

NOW AVAILABLE

Rackmount Keyboards



Three Models: Drawer, Shelf, and Panel
Reasonably Priced

Call or write for descriptive brochures, prices or applications assistance:

INTEGRAND

RESEARCH CORP.

8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203

FAX 209/651-1353

We accept VISA and MasterCard

IBM/XT/AT IBM • 286/386/486 TM INTEL. Drives and computer boards not included.

THE ULTIMATE WORKSTATION

files to applications. Finally, you can carry out most common system-administration jobs through the iconic interface.

We had no difficulty installing any software on the Indigo. Everything about the machine is attractive and fun; it's no wonder that software developers provide excellent support for it. What the Indigo lacks in performance, it more than makes up for in ease of use and support.



Sun Sparcstation2 GX

Say the word *workstation*, and most people will probably think Sun Microsystems. Big screens, paper-white displays, and graphical interfaces have always been its trademark. Sun systems are the quintessential workstations, and application support is phenomenal. A quick browse through Sun's software-support catalog shows just about every possible application category you can imagine—from CASE to CAD to DTP to medical imaging and more.

The Sparcstation2 GX came in a single configuration that we used for both DTP and CAD benchmarking. The "GX" designation means accelerated graphics. Including AutoCAD, our test workstation costs \$25,940; including FrameMaker, it costs \$23,685. Although these prices put the Sparcstation2 GX close to the top in price, our configuration also included several mass-storage options; you can get units minus the CD-ROM drive, QIC tape drive, and 1.3-GB hard drive for \$15,295.

The system is available with a variety of windowing environments, among them Sun's own Solaris Open Windows. Open Windows is a combination development and user environment. The user portion

delivers a set of 15 standard productivity-enhancing applications, including a file manager, text editor, calendar manager, and multimedia mail tool.

Several of these tools are designed to increase group productivity. For example, the calendar manager provides password-protected access to other people's calendars. The multimedia MailTool allows you to attach arbitrary binary files, including audio and image data, to a standard mail message.

The Open Windows environment also provides ToolTalk, a development service that gives users a standard high-level interprocess communications protocol. The major advantage of ToolTalk is that it offers a standardized mechanism through which processes can communicate without your having to hand-craft messages. In addition to interprocess communications, ToolTalk also lets developers send messages to particular objects (e.g., windows, dialog boxes, and text selections) within applications. By creating a standardized tool through which the messages pass, Sun has delivered a backbone around which loosely coupled applications can be arranged.

Open Windows provides a rich environment for both developers and users. However, the Sparcstation2's performance was disappointing. The system's benchmark scores were mediocre despite its speedy graphics: The Sparcstation2 GX was next to last running FrameMaker and came in fifth running AutoCAD.

On the positive side, there are more applications for Sun workstations than for any other Unix workstation. And there are more Sun workstations out there than any other. As with the PC, there is much value in simply being the most popular. But this broad installed base may be misleading in that there have been so many incompatible versions of Sun operating systems and GUIs that you may not be able to take advantage of the newest versions of the operating system with older software.

Unfortunately for the Sparcstation2, being the top gun has a major drawback—people are always shooting at you. The IBM Powerstation/350 beat the Sparcstation2 in speed; the Iris Indigo has a more innovative visual shell. And there are always the Mac and PC-class machines gaining from below with improving performance and much better pricing.

The Sweetest Workstation

Despite our preconception that the sweetest workstation was going to be a Unix system, we chose the Quadra 950 as our favorite. The Quadra is the winner not only because of its performance on our DTP tests, but also because there is more



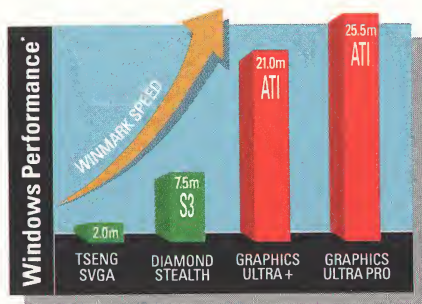
Flatly Refuse to Compromise on Graphics!

Today's graphics cards bulldoze you into a compromise, sacrificing speed for resolution, or resolution for realistic color. ATI's new GRAPHICS ULTRA cards give you all-round performance... speed, color and resolution all at the same time.

Resolution and Color Support	ATI	S3	SVGA
1024 x 768 / 65,000	■	■	■
1024 x 768 / 256	■	■	■

Up to three times faster than competing S3 solutions and even local-bus products, our mach 32 graphics processor propel Windows to an amazing 25 million WINMARKS.*

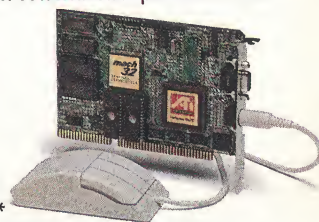
mach 32



Loaded with 2.0MB of video memory, ATI lets you run 1024x768 with 65,000 colors at accelerated speed or work in 24-bit color. All at flicker-free refresh rates up to 76Hz. Our single Windows driver supports painless mode switching, displays a virtual desktop, and provides hardware-accelerated True Type font scaling and smoothing via exclusive ATI CRYSTAL Font technology.

GRAPHICS ULTRA +

- ▶ Fast 21.0 million WINMARK* performance
- ▶ Accelerated 1024x768 at 65,000 colors
- ▶ True color (16.7 million) at 800x600
- ▶ Accelerate multimedia applications**
- ▶ Available in 2.0 MB or 1.0 MB versions
- ▶ Priced from \$399.00***



GRAPHICS ULTRA PRO adds:

- ▶ Fast 25.5 million WINMARK* performance
- ▶ Accelerated 1280x1024 at 256 colors non-interlaced at 74 Hz refresh rate
- ▶ Available in ISA, EISA or Micro Channel versions
- ▶ Priced from \$599.00***



Avoid *crushing* disappointment. Get ATI GRAPHICS ULTRA cards for No Compromise Graphics.

ACCELERATORS • GRAPHICS • MULTIMEDIA • COMMUNICATIONS



Perfecting the PC

ATI TECHNOLOGIES INC.
3761 Victoria Park Avenue
Scarborough, Ontario
Canada M1W 3S2
Tel: (416) 756-0718
Fax: (416) 756-0720

Copyright © ATI Technologies Inc., 1992. All company and/or product names are trademarks and/or registered trademarks of their respective manufacturers. *Winbench 2.5 on 486-33 at 1024 x 768 / 256 colors at 60 Hz. **Multimedia drivers available 11/92. ***Suggested Retail Prices in US\$. Dealers may sell for less. Prices subject to change without notice. Awards based on award-winning technology of GRAPHICS ULTRA and VGA WONDER.

Circle 89 on Inquiry Card.

See Us at COMDEX/Fall '92 LVCC, Booth #1142

software that is better supported and easier to install, manage, and use than for any of the Unix workstations. The Quadra is the ultimate workstation for most computer users. However, its CAD performance was weak, and engineering support is generally lacking.

Our second choice is the IBM Powerstation/350 running AIX. This is our favorite CAD system. We make this selection with some reservation, because the operating system is unusual and its GUI is far behind the others, especially HP's VUE and Silicon Graphics' Workspace. However, the performance results turned in by the Powerstation make it hard to resist.

In third place, surprisingly, is the Compaq Deskpro 50M running DOS (not Windows). Despite its shortcomings when compared to other operating systems, DOS dominates the world; while the user interface may not be the most comfortable,

there is usually someone nearby who knows enough to help a new user get started. We chose this PC-class machine because of its speed and its simplicity. A lot of users simply want a machine that they can dedicate to doing one task very well. Pedrick Yacht Design (which provided our AutoCAD test file) bears this judgment out: Most of its workstation users, Unix and PC users alike, do nothing but run AutoCAD.

Honorable mention goes to the Iris Indigo. This Unix workstation has many of the user-interface attributes of the Macintosh while also offering the best features of Unix. It delivers true multitasking with correspondingly sophisticated memory management, integrated networking, client-server-based applications, and classic Unix shells as command-line interfaces (to simplify complex file management operations and automate multistage file

processing). Silicon Graphics' new R4000-based Indigo, which should be out by the time you read this, may also offer the power of some of the faster workstations.

For us, the decision comes down to this: If you are choosing a workstation for processing power, pick a racehorse like the Powerstation despite the cost. But if you also require a rich user environment and excellent applications support, look beyond traditional Unix systems. ■

Ben Smith and Raymond GA Côté are testing editors for the BYTE Lab. Ben is the author of UNIX Step-by-Step (Howard W. Sams, 1990); you can contact him on BIX as "bensmith" and on the Internet at ben@bytepb.byte.com. Ray has worked in industry designing interpretive languages and user interfaces. You can reach him on BIX as "rgacote" and on the Internet at rgacote@bytepb.byte.com.

COMPANY INFORMATION

Aldus Corp.
(PageMaker)
411 First Ave. S, Suite 200
Seattle, WA 98104
(206) 622-5500
Circle 1331 on Inquiry Card.

Apple Computer, Inc.
(Mac Quadra 950)
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Circle 1329 on Inquiry Card.

Ashlar, Inc.
(Vellum 3D 2.12)
1290 Oakmead Pkwy., Ste. 218
Sunnyvale, CA 94086
(800) 877-2745
(408) 746-1800
fax: (408) 746-0749
Circle 1332 on Inquiry Card.

Autodesk, Inc.
(AutoCAD)
2320 Marinship Way
Sausalito, CA 94965
(800) 445-5415
(415) 332-2344
fax: (415) 331-8093
Circle 1330 on Inquiry Card.

Compaq Computer Corp.
(Deskpro 50M)
P.O. Box 692000
Houston, TX 77069
(800) 345-1518
(713) 370-0670
Circle 1333 on Inquiry Card.

Digital Equipment Corp.
(DECstation 5000/120)
164 Main St.
Maynard, MA 01754
(800) 344-4825
(508) 897-5111
fax: (800) 234-2298
Circle 1334 on Inquiry Card.

Frame Technology
(FrameMaker)
1010 Rincon Cir.
San Jose, CA 95131
(800) 843-7263
(408) 433-3311
fax: (408) 433-1928
Circle 1335 on Inquiry Card.

Hewlett-Packard Co.
(HP/Apollo 9000 Model 710)
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Circle 1336 on Inquiry Card.

IBM Corp.
(IBM RISC System/6000)
Powerstation/350)
Old Orchard Rd.
Armonk, NY 10504
(800) 426-3333
(914) 765-1900
Circle 1337 on Inquiry Card.

Interleaf, Inc.
(Interleaf 5)
Prospect Place
9 Hillside Ave.
Waltham, MA 02154
(800) 955-5323
(617) 290-0710
fax: (617) 290-4943
Circle 1338 on Inquiry Card.

Matrox Electronic Systems, Ltd.
(MG-124)
1055 St. Regis Blvd.
Dorval, Quebec,
Canada H9P 2T4
(800) 361-4903
(514) 685-2630
fax: (514) 685-2853
Circle 1339 on Inquiry Card.

Next, Inc.
(Nextstation)
900 Chesapeake Dr.
Redwood City, CA 94063
(800) 879-6398
(415) 366-0900
fax: (415) 780-3714
Circle 1340 on Inquiry Card.

Radius, Inc.
(PrecisionColor Display/20s,
PrecisionColor 8X)
1710 Fortune Dr.
San Jose, CA 95131
(800) 227-2795
(408) 434-1010
fax: (408) 434-0127
Circle 1341 on Inquiry Card.

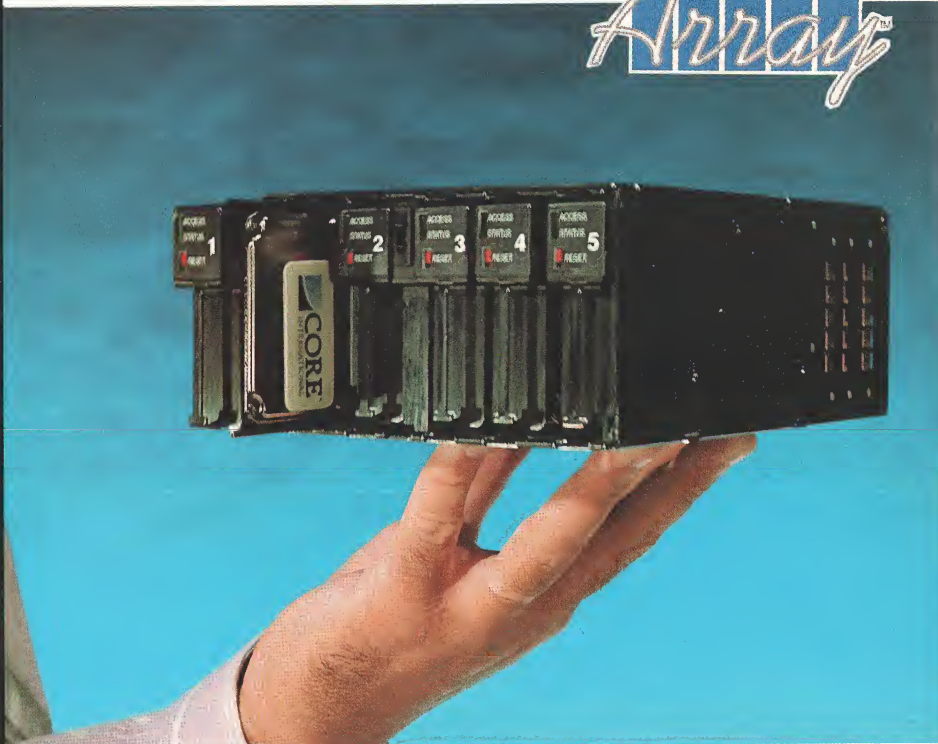
Silicon Graphics, Inc.
(Iris Indigo)
2011 North Shoreline Blvd.
Mountain View, CA 94043
(415) 960-1980
fax: (415) 961-0595
Circle 1342 on Inquiry Card.

Sun Microsystems, Inc.
(Sparcstation2 GX)
2550 Garcia Ave.
Mountain View, CA 94043
(800) 821-4643
(415) 960-1300
fax: (415) 969-9131
Circle 1343 on Inquiry Card.

ViewSonic
(ViewSonic 7)
20480 East Business Pkwy.
Walnut, CA 91789
(800) 888-8583
(714) 869-7976
fax: (714) 869-7958
Circle 1344 on Inquiry Card.

THE DISK ARRAY YOU CAN HOLD IN YOUR HAND...

M I C R O
Array



...FOR LESS THAN \$6,500.

COREwest 310/595-8966
COREeast 201/348-3330
COREsouth/central 407/997-6055
Federal Sales 301/258-8818
CORE International (U.K.) Ltd. 0344 861776
Headquarters & International Sales 407/997-6055

CORE Authorized Distributors

Graydon-Sherman 800/472-9366
Ingram Micro D 800/456-8000
Merisel 800/637-4735
TENEX Data Corporation in Canada 416/291-7151



CORE International, CORE, and Hot Plug are trademarks of CORE International, Inc.
Other trademarks referenced are the property of their owners.
Copyright 1992 CORE International Inc.

Circle 385 on Inquiry Card (RESELLERS: 386)

Now you can have the advanced technology of a fault-tolerant RAID subsystem - down-sized to match the size of a standard 5.25" drive.

MicroArray™ performs functions light-years ahead of mirroring and duplexing and at a cost lower than any other disk array available today!

Each **MicroArray™** provides more than 500MB of capacity and is easy to expand just by plugging in another drive. No reconfiguration necessary. Our design features standard single ended or differential SCSI-2 interface, data striping and five **Hot Plug™** disk drives providing continuous data availability. Daisy chain up to seven MicroArrays per host adapter.

MicroArray™ brings automatic fault-tolerance and RAID level data security to OS/2, Windows and DOS even though those operating systems do not support mirroring or duplexing. **MicroArray™** is also compatible with Novell® and UNIX.

The best news is that **MicroArray™** installs as easily as a standard SCSI hard drive, and it appears to the system as a single drive. No special drivers or controllers needed.

boards that are setting technical standards should also reflect the mood of our time.

Black Magic represents the design alternative that many professional PC users are rejecting from their modern multi-function keyboards.

High-tech in black. Colour variation that matches select interiors.

Black magic.

The new aesthetics in Cherry keyboards.

Find today for further technical details!

January
February
March
April
May
June
July
August
September
October
November
December
Special Issue

[illegible]

Issues
Available

Holland	Dfl 18.00
United Kingdom	£ 5.75
West Germany	DM 16.50

Switzerland	SwFr 14.00
France	FFr 54.50
Sweden	SEK 58.00

No other currencies will be accepted other than those mentioned above.

Please indicate which issues you would like by checking(✓) the boxes.
Send requests with payment to:

BYTE Back Issues, c/o Dynamic Graphics International, P.O. Box 25, 3950
AA Maarn, The Netherlands

☐ Check enclosed

Charge: ☐ MasterCard ☐ Eurocard ☐ VISA ☐ American Express

Card# _____

Exp. Date _____

Signature _____

Name _____

Address _____

Postcode _____ City _____

Country _____

All orders must be prepaid. Pay only in currencies given.
Please allow three weeks for delivery by surface mail.



available as compact keyboard and standard multi-function keyboard with various layouts for different countries.

992 by Cherry Mikroschalter GmbH
Circle 377 on Inquiry Card

Compu\$ave

MAIL ORDER EXPERIENCE SINCE 1985

Nat'l Orders (800) 544-8302
Int'l Orders (602) 437-8208

Info (602) 437-8298

FAX (602) 437-8988

COMPU\$AVE SYSTEMS

486-33 2317
486-50 2419
All Systems include: 1.2 FD,
8MB RAM, 256K CACHE,
120 MB HD, 101 KB, 2 Serial,
1 Parallel, Diamond Stealth
w/1 MB Card, 14" NI Monitor
**CALL FOR CUSTOM
CAD CONFIGURATION**

BOARDS

Adaptec 1542BK 267
Advanced Digital Save
Alloy Call
Artist WinSprint Call
Calcomp Draw Card Save
Computone Call
Digiboard Call
Diamond Stealth 245
DPT Smart Cache Call
Hercules Grip Stat Call
Jovian Grabber Call
Metheus 1104+16 843

Anthem/Novell NE-2000 152

NEC Graph Eng 594
Number Nine Call
Orchid 1280-1mb 327
Plus HC20 325
Plus HC40 555
STB Call
Trident Save
Vermont Call
Video 7 Call

TAPE DRIVES

Alloy Irwin
Archive Maynard
Core Int Mountain
Everex Tecmar
Iomega Wangtek

Summit Call For Prices

MULTIPLEXERS

Mux 900 Series-4 Chan 726
Mux 900 Series-8 Chan 896
Mux 1600 Series-8 Chan Call
Mux 1600 Series-16 Chan Save
Mux w/9.6 Intrl Modem 2138

X-TERMINALS

Tektronix XP11 1325
Tektronix XP13 1550
Tektronix XP15 1925
Tektronix XP17 2225
Tektronix XP20 Series Call
Wyse X5 w/KB 1342

COMPUTERS

ALR Bus. V 386/33 1559
ALR Bus. V 486/33 1951
ALR Bus. V 486/50 4135
Acer 1120 UX 1059
Acer Pwr 500 486/33 2016
Acer Mate 386/20 698
Acer 1125E 386/25 1353
Samsung 386SX-25 863
Samsung PM 486/33 1690
Samsung SM 486/33TE 3722
Texas I TM2000/40 1267
Texas I TM3000/20 1845
Texas I TM3000/30 1970
Texas I TM3000/60 2650

Texas I TM4000 Call

DIGITIZERS

Calcomp 12x12-4 299
Calcomp 12x18 600
Hitachi Call
Kurta XLP 237
Kurta IS/1 12x12-4 335
Kurta IS/1 12x18-4 595
Seiko DT-3613 274

Summa Sketch II 290

Summa Sketch Pro. 524

Wacom SD510C 541

Call FOR LARGER SIZES
CALCOMP, SUMMA, KURTA

SCANNERS

Alps PSX300G w/OCR 1313

Calcomp "E" Size. 8622 70436

Canon IX30F w/kit 1319
H.I. Scan CAD 1998
Howtek Call
Logitech Call
MicroTEK 600G 769
MicroTEK 600Z 1328
MicroTEK 1850 Slide 1724
Panasonic RS307U 850
Panasonic RS506U 850
Pentax 100 587
Sharp JX320 1015
Complete PC Flatbed 955

Complete PC
Full Page /GS & OCR 657
Page Scnr /GS & OCR 477

NETWORK SOFTWARE CALL

PLOTTERS

AMT & Turbo 1278
Calcomp 1026m 5600
Calcomp 2024 2957
Calcomp 2036 3855
Calcomp 1044GT 8527
Calcomp 1070 15069
Calcomp 8902 3029
Calcomp DM52224 10297
Enter SP600 580
Enter SP-1800 2625
Enter SP-2800 3227
Enter SP-4820 4520
Enter SP-4830 4584
H.I. DMP52 2002
H.I. DMP61 2429
H.I. DMP161 2802
H.I. DMP62 3219
H.I. DMP162 3644
H.I. DMP162R 4839
H.I. Imagemaker 701
H.P. 7440A 957
H.P. 7475A 1368
H.P. 7475B 1574
H.P. 7550B 2919
H.P. 7570A 2660
H.P. 7575A 3199
H.P. 7576A 4199
H.P. 7595C (SX+) 5254
H.P. 7596C (RX+) 6652
H.P. 7599B (MX+) 7703
Design Jet 7702
Paint Jet 751
Paint Jet XL 1711
Paint Jet XL300 2535
Ioline 3700-8 2902
Ioline 4000-1 3243
Ioline 4000-8 3447
Ioline SG4000-1 3721
Ioline SG5400-1 8952
Ioline 7200-1 10229
Ioline SG5000-M 4129
Roland DXY-1100 752
Roland DXY-1200 1027
Roland DXY-1300 1371
Roland CAMM-1 1975
Roland GRX-300AG 3330
Roland GRX-400AG 4120
Roland DPX-2500 3433
Roland DPX-3500 4120
Roland DPX-4600 9997
Sticka 699
Sketchmate 465
LTX-120 2058

CD-ROMS

CD Tech Porta Drive 712
Hitachi 1750S 644
NEC CDR-73M 577
NEC CDR-83M 497
NEC CDR-36 Gallery 552
NEC CDR-73 Gallery 775
Pioneer DRM600 906
Sony CDU 541 w/Kit 515
Sony CDU 7211 w/Kit Call
Sony 7205N 575

PRESENTATION MONITORS

Mitsubishi 33" 3495
Mitsubishi 37" 5375

MONITORS/ TERMINALS

Adds Call

Amazing CM 8428SX 309

Amdek 738N 389
Arche Call
CTX Super VGA 317
CTX 5468 NI 350
Goldstar 1460+ 309
Goldstar 1620+ 750
Hitachi 20AS 1839
Hitachi 2085M 1420
IBM 3151-310 490
IBM 3151-510 463
Idek 5217 Call
Link MC 2 w/o KB 213
Link MC 5 w/o KB 274
Link MC 6 w/o KB 345
Magnavox CM 9039 241
Mitsubishi SD4533C 438
Mitsubishi 1429C 403
Mitsubishi 16L 895
Mitsubishi 20L 1837
Nanao T660 2650
Nanao 9070U 834
Nanao 9080I 1055
Nanao T560I 1934
Nanao F750I 2135

NEC 5D 1775

NEC 2A 406
NEC 3FGX 699
NEC 4D-S 1024
NEC 4FG 843
NEC 5FG 1510
NEC 6FG 3110
Seiko CM 1440 461
Seiko CM 1450 556
Seiko CM 2050 1836
Sigma Designs Call
Sony 1302 557
Sony 1304 620
Sony 1604S 1048
Sony 1936 2353
Sony 1320 351
Televideo 955 473
Televideo 965 373
Toshiba Call
Viewsonic Call
Wyse 30+W/KB 278
Wyse 50 W/KB 365
Wyse 60 W/KB 389
Wyse 150 W/KB 366
Wyse 160 W/KB 431
Wyse 185 W/KB 355
Wyse 370 W/KB 900
Wyse 670 453

THERMAL PRINTERS

Mitsubishi S340 8633
Mitsubishi S3600 Call
Mitsubishi G650-10 4179
Mitsubishi G500A-10 3239
Mitsubishi G370-10 3420
NEC Colormate PS40 4550
Seiko CH5504 Call
Seiko CH5514 Save

PRINTERS

Alps Save
Canon BJ10EX 337
Canon BJ330 546
Canon LBP-8 Plus Call
Canon LBP-4 Plus Save
Citizen GSX-140 280
Citizen 200GX 159
C. Itoh CI-400+ 4032
C. Itoh CI-800+ 5495
C. Itoh C5000 1359
Data Products Call
Fujitsu DL3600 482
Fujitsu DL5600 1192
Genicom 4470XT 9870
Genicom 4490XT 11913
Genicom 1040 Call
Genicom 3840E 1761
Kyocera Call
Lexmark Save
Okidata 391+ 580
OTC 850XL 1386
Panasonic Call
QMS PS-410 1606
QMS PS-810 2681
QMS PS-815 3739
QMS PS-820 3553
QMS PS-825 3602
QMS PS-815MR 4072
QMS PS-825MR 4811
Qume Crystal Print /52 667
Qume Crystal Print II 1892
Qume Express Laser 2671
Seiko Smart Label Plus 169
Texas I. PS17 1205
Texas I. PS35 1481

MODEMS

Everex Call
Multitech 224BA Save
Multitech 932BA Save
Multitech 1432BA Call
Telebit T-1000 459
Telebit T-2500 627
Telebit T-3000 627
US Robotics DS/E 835
US Robotics DS/I 781
US Robotics HST/E 585

Phones Are Open Mon-Fri: 7 am -5 pm Mailing Address: Compu\$ave - 4209 S. 37th Street, Dept. S'8, Phoenix, AZ 85040.
Prices reflect U.S. currency and are subject to change without notice. We do not guarantee compatibility. DOA's are replaced or repaired. Any return requires a RMA#. 15% Restocking charge on returns. Our service dept. number is (602) 437-8298. All products carry manufacturer's warranty only. We do not honor rebates, extended guarantees or promotional programs. Mastercard and VISA are accepted. International orders add 5%. Please call or FAX before ordering.

486 Systems for a Graphical World

**These 26 33-MHz
486 systems strike a
solid balance between
cost and performance**

**HOWARD EGLOWSTEIN
AND STAN WSZOLA**

applications at the same time. Although 386 systems offer more than enough processing power for standard DOS office work, they simply can't handle the demands of multitasking.

Our review of moderately priced systems compares 26 machines worth considering—some from the biggest vendors in the industry. Many are brands you're sure to have heard of; others are from firms you may not recognize. The features table starting on page 218 provides background on the full complement of systems, which includes models from Advanced Logic Research, Atlas Industries, Axik, Bi-Link, Comex, Compaq, CompuAdd, CompuTrend, Daly, Dell, DFI (Diamond Flower), Duracom, Everex, Gateway 2000, Insight, Lodestar, NEC, Northgate, Packard Bell, Polywell, QSI, Tandy, Tangent, Tri-Star, Uniq, and Wyse.

What makes a good 486? We'll cover that in more detail in a moment, but in essence, we looked for a blazingly fast machine that uses standard components and comes packed in a standard case with plenty of room for upgrades. We also looked for a company that will be around for the duration of the computer's warranty.

The Criteria

All the machines tapped for review have a 486DX CPU running at 33 MHz, 8 MB of RAM, one or two floppy drives, a keyboard, a hard drive with a capacity of about 200 MB, and a Super VGA adapter capable of displaying a

If you think that a shiny new 33-MHz 486 computer is out of reach, you should take another look. We did and found that \$3500 buys you a lot more computer these days than it used to. And a 486 is more than a luxury. If you're planning to do any serious work with Windows, OS/2, Windows NT, or Unix, a fast 486 CPU is practically a necessity. These operating systems and environments demand fast video, large and fast hard drives, and lots of memory. A 486 CPU also is a must if you need to run multiple

resolution of at least 800 by 600 pixels. Vendors that bundle in Microsoft Windows with their systems usually also include a mouse. To meet our price ceiling, the complete system with DOS and a monitor must retail for under \$3500. If you consider the price that some of the big name brands sold for just a few months ago, this is no mean feat for companies that historically charge top dollar for high-end machines.

Part of what makes this target price so accessible is the ready supply of standardized parts. We discovered that many of the machines have motherboards from AMI, and high-quality hard drives from Maxtor, Conner, and Western Digital were common. The video cards varied widely, but a few systems came with boards from top-notch firms, such as Orchid, Diamond, and ATI. A few vendors shipped us machines with local bus video and disk-caching controllers.

By our reckoning, the machine you buy today must satisfy your company's needs for some time. That means it has to run not only today's software, but it also must have enough flexibility to run new software coming down the pike. Programmers will continue to write software that consumes ever-increasing amounts of disk space and RAM, and you don't want your new machine to become obsolete overnight. The best way we've found to ensure longevity is to compare machines operating system by operating system, benchmark by benchmark, and component by component.

continued



Three of our favorites: the Lodestar 486 LB Data Master, the Compaq Deskpro 4/33i Model 210, and the Axik Ace Cache 486All-33.

BYTE ACTION SUMMARY

■ WHAT 33-MHz 486DX SYSTEMS ARE

Complete computer systems that are based on Intel's 486DX chip and run at 33 MHz. Many systems reviewed here are priced under \$2500.

■ LIKES

Competitive pricing has reduced the cost of a powerful 486DX machine to an affordable level.

■ DISLIKES

Price reductions in faster 50-MHz 486s may quickly make 33-MHz machines obsolete.

■ RECOMMENDATIONS

Standard desktop and tower cases offer the most flexibility. Axik's Ace Cache 486All-33 and Lodestar's 486 LB Data Master are two such systems. Both offer excellent performance. Among the proprietary machine designs, the Compaq Deskpro 4/33i Model 210 is our favorite.

The Sum of Their Parts

To start the testing, we installed MS-DOS 5.0 and Microsoft Windows 3.1 on each of the machines and then ran BYTE's low-level CPU, FPU, disk, and video benchmarks (see the graphs on page 224). The next step was running our DOS and Windows applications suite. Finally, we installed The Santa Cruz Operation (SCO) Unix version 3.2.4 and fired up our Unix test suite. Running Unix provides us with a third method of exercising the disk subsystem and checking for any system design faults that may make the machine incompatible with alternative operating systems.

The tests dealt us a few surprises. We expected that because all the systems use a 33-MHz CPU, the results for the CPU and FPU benchmarks would be similar. The sometimes wide gaps that surfaced point out the positive effect that disk-caching controllers, high-speed drives, and accelerated video can have on performance. The DOS and Windows applications suites also were revealing. Machines with especially speedy disk drives and fast video have a definite advantage here. The database and desktop publishing portions of the tests, in particular, take full advantage of these features.

For judging the compatibility of the primary computer component—the motherboard—the best test we have is our low-level benchmarks (which directly

analyze both a machine's hardware and ROM BIOS) and the applications test suites. Machines are, for the most part, fully compatible if they can run a good selection of the most popular software. Our test suites do a good job of ferreting out a computer that may have future incompatibilities.

If you're planning to run DOS or Windows, a good quality BIOS is a must. We prefer to see ROM BIOSes from companies with sufficient resources to test them carefully—companies such as AMI or Phoenix or large manufacturers, such as Compaq, that write their own BIOS code. Another advantage of using a machine that accepts a standardized BIOS is "upgradability." It's likely (although not guaranteed) that you can upgrade an AMI or Phoenix BIOS ROM at a later date, if the need arises.

The ability to add more RAM—as much as 16 MB and preferably in standard SIMM or SIPP (single in-line pin package) configurations—is another primary consideration. Be wary of machines that require special proprietary memory configurations, unless you know you can get memory if you need it. Otherwise, you may be locked into buying the RAM from the computer's vendor, which can prove expensive. Happily, numerous third-party vendors traditionally support Compaq's proprietary memory configurations.

continued

Decisions, decisions, decisions.

Decider, decider, decider.

own-sizing, upgrading, multi-platform environments. Today's computer hardware issues are more numerous, more difficult, more critical than ever. So how do companies make decisions?

According to a new IntelliQuest study, they turn to the only person qualified to decide. Someone like Bob Barrett. A person with 18 years in computers. Who oversees a technical staff of 75. And whose buying decisions and approvals affect nearly 3,000 users worldwide.

In other words, they turn to the BYTE reader. A full 92% of whom control the products and brands their companies buy.

If you want to reach an audience as influential as this, then yours is an easy decision—advertise in BYTE.

BYTE reader Robert N. Barrett, Vice President Management Information Systems, M/A-COM, Inc.

It doesn't get bought without



ISA or EISA bus? The benchmarks don't have much to tell in this regard, because this choice doesn't make as much difference as vendors may tell you. Most of a 486's functions are integrated onto the motherboard; video, disk-caching controllers, and network adapters are the only cards that usually take advantage of the EISA slots. With local bus video cards and a disk-caching controller, you'll get plenty of performance. Whether the extra boost EISA gives you on a network adapter is worth the money is something you must decide. In our view, people who really need this level of speed probably should buy something beefier than the systems reviewed here. A 50-MHz machine isn't that much more expensive, and it provides the raw horsepower needed to take full advantage of EISA's throughput.

Of course, you'll want a good monitor and keyboard. Luckily, keyboards are inexpensive enough that, for well under \$100, you can replace a poor one with something respectable. Monitors are a bigger problem, because many bundled ones are barely usable, even at 640- by

480-pixel resolution. If possible, look for machines that offer name-brand tubes from larger third-party companies, such as NEC or Viewsonic. Another good test is to ask how much you can save on the system price by omitting the bundled monitor. If the vendor subtracts only \$250 or \$275, chances are that the monitor is of poor quality. You may want to buy the system anyway but plan on buying another display.

In general, local bus video or accelerated video cards will greatly improve a system's performance on graphics-intensive applications, if you have the right drivers. Card manufacturers almost always provide drivers for Windows and AutoCAD. Check with the vendor to make sure your fancy new card supports your application.

Finally, consider your disk storage needs. Do you need a disk-caching controller? Some operating systems require you to disable the cache if you have it. DOS and Windows can use some of your system's memory as a disk cache (sometimes more effectively than a caching controller can), and if you're putting together a file server, Novell NetWare

does plenty of its own caching in software. On systems with slower CPUs, putting a cache on the controller makes sense; it's not so clear-cut on 486 machines.

One last thing: You may need some help with your new machine or want some help debugging that big scary card you add next year. If you buy a machine with proprietary parts or case designs, you're locked into that vendor for support and upgrades. Ask yourself whether the firm will be around when you need it. Will the company still support your machine in a few years? All other things being equal, we prefer machines that use standard "clone" cases and motherboards. If your vendor can't—or won't—support you in the future, you can call any local computer dealer for parts or service. Proprietary designs may give you smaller footprints or a lower profile, but you'll have to weigh for yourself whether small really will prove beautiful in the long run.

A Look at the Numbers

The BYTE low-level benchmarks isolate specific parts of the system and test each

UNIX Developers!

The only dongle smart enough for any open systems application.

Introducing MicroSentinelUX

It's simply the ultimate tool for providing developers more revenue generating options — and ensuring that you get paid for software that's used.

In fact, it is the most effective hardware key for open systems and UNIX applications. And it works on any hardware platform.

A Hardware Key With Brains

The real magic of MicroSentinel is its onboard intelligent micro-processor. This makes the key smart enough to provide the ultimate in cross-platform flexibility and marketing value. Each key features an algorithm

and 32 bytes of non-volatile read/write memory. This allows the developer to customize the key for specific applications.

Cross-Platform Flexibility

MicroSentinelUX is flexible enough to be used as a portable host-ID on Sun, DEC, Silicon Graphics, Apollo, HP, even PCs and more. The key attaches to any RS-232 port and the software is instructed to look for it. Its operation is transparent to the user. Developers use it to control distribution, meter usage, count concurrent users, and much more. And, it's easy and quick to integrate into your application.

Try One Today.

Be smart. Order a low-cost evaluation package today from the UNIX specialists at world leader Rainbow Technologies.

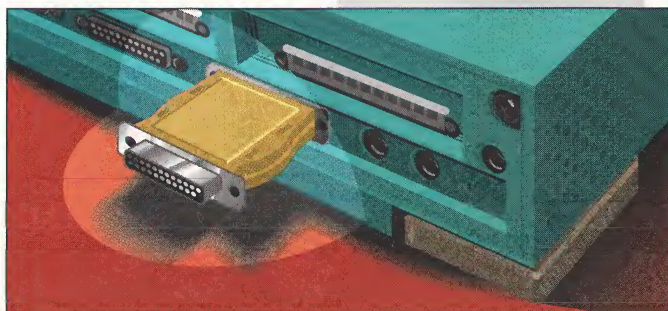
SENTINEL
Securing the future of software

Call for more information:

1-800-843-0413

Look what MicroSentinelUX can do for you.

- Make demos and leases more secure
- Controls distribution
- Provides alternative to host-ID security
- Allows portability
- Manages site licenses
- Protects unauthorized use or duplication
- Update/upgrade software remotely



RAINBOW
TECHNOLOGIES

MICROSENTINEL HEADQUARTERS

9741-I SOUTHERN PINE BLVD., CHARLOTTE, NC 28273 ■ 704/523-9500 ■ fax 704/523-7651

MicroSentinelUX is a trademark of Rainbow Technologies, Inc. All other products and brand names are trademarks of their respective owners.



© 1992 Optique, Inc.

Stop Looking

and start examining the brilliant, sharp image of our 17" Optique 4000D • With it's Invar Shadow Mask, you can display color intensive images that are razor sharp and 20% brighter than conventional monitors • Its flat, square screen offers a consistent overall, edge-to-edge image with reduced distortion at the corners • Higher refresh rates permit a flicker-free picture, and micro-processor controls allow 28 preset modes while adhering to strict Swedish MPR II low radiation standards • Your eyes will appreciate 36% more viewing area than 16" displays along with a non-glare screen and 1280 x 1024 resolution • And all this at a sensible price • So, if image quality at .28 dot pitch and 76Hz refresh rate meets your standards, stop looking and start dialing (800) 843-6784 • Ask about our award winning 2000D 15" flat, square screen, too.

See us at
COMDEX/Fall '92
 Booth # H-8418

OPTIQUEST

Circle 66 on Inquiry Card

separately. The CPU tests perform integer math functions and memory movement. By shuffling 8-, 16-, and 32-bit pieces of memory, the CPU test can pick out motherboards designed with crippling memory configurations or equipped with large external caches.

The FPU tests don't mean much on a 486DX. The FPU always is the same built-in coprocessor that all other 486 chips have. Because, on these machines, the coprocessors all run at the same clock speed, we expect the performance to be essentially the same. Disk performance is greatly improved by caching controllers; likewise, a good on-board or local bus video design provides better performance on the video tests.

The applications and Unix tests provide an extra measure of compatibility and performance in real-world situations. The DOS and Windows tests are broken down into word processing, spreadsheet, database, CAD, and scientific areas. Because most users run a variety of these applications, we've combined the benchmark results into two overall indexes: one for DOS and one for Windows.

As noted earlier, the low-level benchmark results followed a pattern. Machines that incorporate fast disk systems turned in the best disk performances. In particular, the Northgate Elegance ZXP and the Uniq UTI 486DX-33 easily led the pack. The Tandy 4833 LX/T had a very sprightly video performance—something we usually don't see in Tandy machines. The CPU performance varied depending on memory configuration and cache size. A few machines—most notably the Dell 486D/33, DFI Diamond Series Model 433D, and Everex Tempo M Series 486/33—had lower CPU ratings than our reference machine, a Compaq 386/33L. The Compaq is a speedy 386, but we didn't expect it to beat any 33-MHz 486es. Except for the Dell, the systems' FPU performances were much faster than the Compaq 386's 387 coprocessor. We've seen similarly slow performance on other Dell machines, so this didn't surprise us. The Dell, however, did manage to hold its own on the applications tests, where it counts most.

On the DOS and Windows applications tests, those machines with the best DOS

performances also turned in shining Windows results. Axik's Ace Cache 486All-33 and Lodestar's 486 LB Data Master were clear standouts in the applications suites. The Unix tests were less conclusive. The machines from Comex, Lodestar, Northgate, and Tangent all earned an impressive score of 1.6.

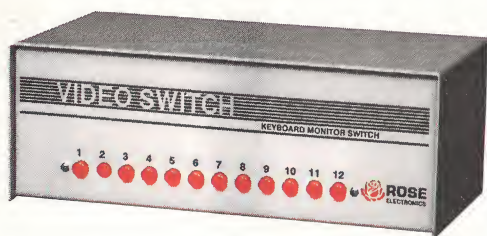
The Last Detail

After running the performance tests, we factored in the other considerations and found three machines worth recommending. The Axik Ace Cache 486All-33 performed well and shipped with a 14-inch Viewsonic 6e display. The Axik's case is a baby tower configuration that provides easy access to the system's vital parts and easy upgradability. Similarly, the Lodestar did well on our tests and comes in a baby AT case.

Neither the Axik nor the Lodestar comes in the popular "low-profile" styling. If you have to put the machine on your desk, and you *need* a low-profile case, the Compaq Deskpro 4/33i is a better-than-average performer. The Deskpro's display and keyboard are

Your Choice of Keyboard Monitor Switches

Access multiple computers with a single keyboard and monitor to cut equipment costs, save valuable space, and end clutter



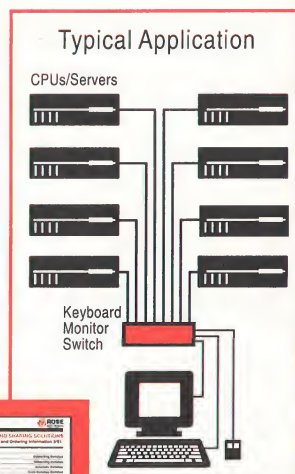
Manually controlled unit

- Simple pushbutton operation for quick selection
- Four, eight, or twelve ports per unit
- Daisy-chaining connects unlimited number of CPUs
- Compatible with EGA, VGA, Macintosh, Sun, and others
- Optional keyboard booting for 286, 386, and 486
- Optional RS232 or PS/2 mouse interface
- PCB construction for high reliability and low crosstalk
- Rack mount, matrix, and customized units available

- Switch by keystroke, from front panel, or RS232 port
- Two or four ports per unit
- Cascade units to support up to 255 CPUs
- Supports monochrome, EGA, and VGA
- Includes keyboard booting for 286, 386, and 486
- Includes RS232 and PS/2 mouse interface
- LEDs display selected CPU and CPU power-on
- Scan function switches among CPUs automatically



Keyboard controlled unit



Call toll-free now for your copy of our Switching and Sharing Solutions catalog.

Other Rose products: Print servers, printer sharing units, print buffers, keyboard monitor extenders, video splitters. All Rose products are US-made and have a 1-year warranty.

Make the Rose Connection

10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713) 933-7673 • Fax (713) 933-0044

ROSE
ELECTRONICS

1-800-333-9343

A PC IS A TERRIBLE THING TO WASTE.

IBM PS/2 Models 70 & 80 and Compaq Deskpro

386 systems have a future with 486/Now!

processor upgrades.


Every year or so, a new version of your favorite software comes out. Ideally, the updated version is easier to use, has new features and hopefully makes you more efficient. To get the most from these improvements, you need 486 processing power. Until now, your only solution was to buy a whole new system. In addition to the cost, this meant re-installing software and buying new peripherals.

Don't Replace the System—

Simply Upgrade the Processor.

A better alternative is to upgrade only the processor. 486/Now! from Kingston is a great way to get the processing power you need for business applications, network file servers, graphics programs and CAD/CAM. 486/Now! is available with either a 486DX 33MHz or a 486SX 25MHz, and has an on-board clock for optimum processor performance.

The Solution For 286 Systems.

SX/Now! is a great way to upgrade 286 systems from IBM, Compaq, AST, HP, Epson, NEC, Toshiba and Zenith to a Windows and OS/2 ready  Am386SX, the fastest 386SX available. SX/Now! features 16kb of fast cache memory, supports a 387SX co-processor and has an on-board clock.

Easy Installation, Compatibility, Unquestioned Reliability.

Kingston processor upgrades plug directly into the system board, won't interfere with bus slots and take only about ten minutes to install. They're

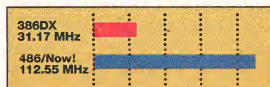
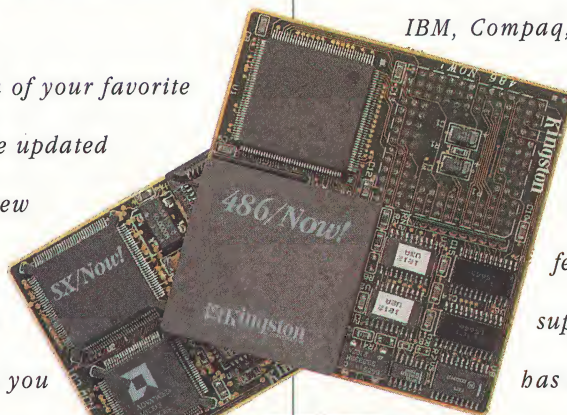
guaranteed fully compatible with both the systems for which they were designed,

plus all popular operating systems and applications.

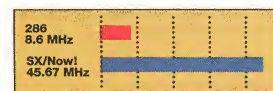
486/Now! and SX/Now! carry five-year warranties.

For the power you need and the reliability you expect, call Kingston at (800) 835-6575 for more information or the name of a reseller near you.

Comparison of native Compaq Deskpro 386/20e and same system with 486/Now! 486DX-33MHz Landmark Speed Test 2.02. Comparison of native IBM PS/2 Model 50 and same system with SX/Now! 386SX-33MHz Landmark Speed Test 2.03. All trademarks are of their respective owners.



servers, graphics programs and CAD/CAM. 486/Now!

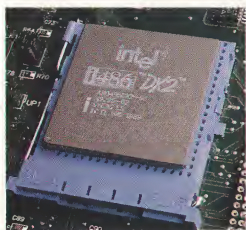


interfere with bus slots and take only about ten minutes to install. They're



THE INSIDE NAME IN UPGRADES

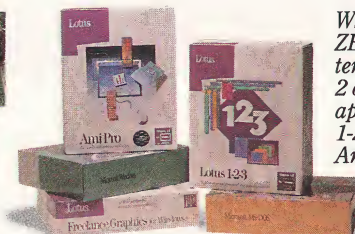
17600 Newhope Street, Fountain Valley, California 92708 (714) 435-2600 Fax (714) 435-2699



Pick your power! 486SX-25 thru the 486DX2-66. And upgrading is easy with our Zero Insertion Force (ZIF) socket. Note the extra row of pins for the future OverDrive™ CPU based on Intel's P5 technology.



The on-board SCSI option lets you add SCSI I or II devices anytime. SCSI hard drives, opticals and more are easy to add.



When you buy any ZEOS Windows system you can choose 2 of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro and Freelance Graphics for Windows!

ZEOS® Gives You More.



You simply get more. For less. When everyone else started cutting prices by giving less, ZEOS had a better idea—Use the very latest technology to design an entirely new line of high performance upgradables that allow us to *charge less while giving more.* You're going to love it!

ZEOS. THE UPGRADABLE EXPERTS.

Nobody knows upgradability better than ZEOS. After all, ZEOS was one of the first to introduce truly high-performance upgradable PCs. Now using the latest in high-integration technology we've made a good thing even better, right up to the 486DX2-66 and beyond.

How far beyond?

Try the future OverDrive™ processor based on Intel's P5 technology! Start today with the 486 CPU of your choice. Select between the 486SX-25 or 33, the 486DX-33, the 486DX2-50 or the 486DX2-66. Then, in 1993, you'll be able to add the new super processor (you'll note the extra row of pins around each side of your CPU upgrade socket; that's what they're for). Maximum power today *and* tomorrow.

Consider the Vertical Option. We can build your new upgradable system in our eight-bay vertical case. It comes complete with our high-capacity power supply and two cooling fans. Add only \$95.

TWO VESA STANDARD LOCAL BUS SLOTS.

While the others are talking about local bus, often creating their own non-standard solutions, ZEOS gives you a VESA future. As a working member of the VESA Standards Committee, ZEOS has incorporated *two* slots conforming to the recently established VESA standard.

What does this mean to you?

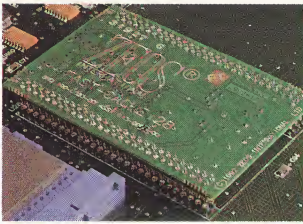
Unparalleled VESA local bus performance! We've taken one of your two VESA local bus slots (which can also be used for standard 16-bit cards if you wish) and added a *screaming* local bus video card. Windows has never moved so fast! And with our bus mastering capability, a second local bus card can be added in the future as well. ZEOS gives you more performance options than anyone else. *Take a closer look!*

PEAK PERFORMANCE. A ZEOS STANDARD.

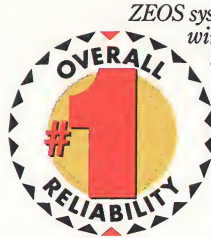
With ZEOS, performance enhancements are standard. If you have a technical bent you'll love reading about them. If you're a typical user, just tell your friends your new ZEOS system has these things. They'll be impressed. Like what?

Mention your new system has FLASH





You can upgrade your system now or in the future with our optional 128K or 256K secondary cache modules.



ZEOS systems feature award-winning reliability and support. Nine times PC Magazine's Editors' Choice.

BIOS for easy BIOS upgrades via disk or modem. Also mention your true 80486 VLSI chip set with burst mode memory support; talk about your high-speed memory expandable to 64MB. Mention your fast IDE HDD controller and your hard drive with its own built-in cache. Then talk about the other ZEOS performance options. Like your upgradable high-speed cache!

THE CACHE OPTION IS YOURS.

Because painfully missing from many competitors offerings is the option for a secondary cache. With ZEOS you can add a secondary cache of 128K or 256K. This speeds up many memory-intensive applications. Take it now or add it later if you wish. ZEOS gives you the option. And that's just for starters.

ON-BOARD SCSI IF YOU WISH!

Because your new ZEOS upgradable offers you the additional option of on-board SCSI. By simply adding a single socketed SCSI chip to the board your new ZEOS system supports both SCSI I and SCSI II-type devices. You can now have SCSI hard drives (running *in addition* to your standard IDE drives) plus tape backups, optical drives and a host of other SCSI peripherals. Take it now or add it later. Only from ZEOS.

MORE FEATURES. MORE BENEFITS.

Like the two cooling fans you'll find in every ZEOS system. While ZEOS systems run cooler than most with *one* fan we still give you *two whisper-quiet cooling fans*. The cooler your system runs the longer it will last. We also include a built-in surge suppressor in every system. These are extra features the others *can't* or *won't* offer you. From ZEOS, they're yours. No additional charge.

FREE LOTUS SOFTWARE TOO!

And don't forget, when you purchase any new ZEOS Windows-based system, you will also receive your choice of two:

Lotus 1-2-3 for Windows, *Ami Pro*, and *Freelance Graphics*. The software alone carries a suggested retail price of over \$1,000 and we're giving it to you absolutely free. Now that's ZEOS Value.

24-HOUR-A-DAY SUPPORT. AND MORE!

Remember too, ZEOS provides you with our top-rated 24-Hour-a-Day Toll-Free Technical Support. *Plus* your new ZEOS system is covered by our 30-Day Money-Back Guarantee, One Full Year Limited Warranty, and our Express Parts Replacement Policy.

CALL NOW TOLL FREE.

800-423-5891

Ordering your new ZEOS upgradable system is easy. Simply pick up the phone and give us a call. A friendly and knowledgeable ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS system.

Why not give us a call right now!

Purchase orders from Fortune 1000 companies, governments and institutions subject to approval. Leasing programs are available. All prices and specifications are subject to change without notice. Please call to confirm pricing, specifications and warranty details. The following are trademarks of their respective companies: ZEOS (ZEOS International, Ltd.). ©1992, ZEOS International, Ltd., 530 5th Avenue N.W., St. Paul, MN 55112 USA. ZEOS is a publicly traded company (NASDAQ symbol: ZEOS). UPR-BYT-9211

PICK YOUR POWER.

Or we can custom-build a system to your exact specifications!

- Your choice of CPU with upgrade options.
- 8MB of RAM expandable to 64.
- A full 245MB high-speed IDE hard drive with built-in cache.
- Both 1.2 and 1.44 Teac® FDD.
- ZEOS 14" Hi-Res 1024x768 non-interlaced VGA color monitor with 1MB high-speed VESA Local Bus card.
- Two serial and one parallel port.
- Shadow RAM/EMS support.
- Optional SCSI port (plug-in chip) for SCSI I & II devices.
- Upgradable high-speed cache options of 128K and 256K.
- Flash BIOS for easy BIOS upgrades.
- High-capacity power supply with built-in surge suppression.
- Rugged ZEOS SpaceSaver case with seven drive bays and two cooling fans.
- ZEOS RS/101-key keyboard.
- Microsoft DOS, Windows and a genuine Microsoft Mouse, plus your choice of two Lotus applications for Windows!
- ZEOS 24-Hour-a-Day Toll-Free Technical Support and complete Customer Satisfaction Package.

486SX-25	\$2295
486SX-33	\$2495
486DX-33	\$2695
486DX2-50	\$2895
486DX2-66	\$3095

ORDER NOW TOLL FREE
800-423-5891

Fax Orders: 612-633-1325
Government: 800-245-2449
TDD Orders: 800-228-5389
Outside U.S. and Canada:
612-633-6131
MasterCard, VISA, Am Exp,
Discover, Z-CardSM COD
and Leasing Programs.
Open 24 Hours a Day,
365 Days a Year!



33-MHZ 486DX DESKTOP COMPUTERS

Make sure you get everything you expect from a 486 system. Consider your upgrade options by checking the support for processors, the number of drive bays, and maximum RAM.

COMPANY MODEL	Advanced Logic Research, Inc. Flyer 32LCT Model 340DW	Atlas Industries, Inc. Atlas-DX33	Axik Computer, Inc. Ace Cache 486All-33	BI-Link Computer, Inc. DT 433	Comex Computer Corp. Comex 486DX/33	Compaq Computer Deskpro 4/33 Model 210
CHIPS						
Processors supported (chip/speed)	486SX/25; 486DX/33 and 50; 486DX2/66	486DX/33; 486DX2/66	486DX/33; 486DX/50; 486DX2/66	486DX/33; 486DX2/66	486DX/33	386DX/33; 486SX/25; 486DX/33
Uses cache	●	●	●	●	●	●
CPU upgrade available	●	●	●	●	○	●
External coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None
Brand of motherboard chip set	ALR	UMC	Contaq	UMC	Micronics Gemini	Intel
Brand of BIOS	Phoenix	AMI	AMI	AMI	Phoenix	Compaq
MEMORY						
Standard RAM (MB)	8	4	4	4	4	4
Maximum RAM (MB)	64	32	32	32	64	32
No. of wait states	None	None	None	None	None	None
Standard cache (KB)	0	64	64	64	256	64
Maximum cache (KB)	256	256	256	256	256	64
STORAGE MEDIA						
Standard floppy configuration						
Drives and types	1.44-MB 3 1/2-inch	1.2-MB 5 1/4-inch; 1.44-MB 3 1/2-inch	1.2-MB 5 1/4-inch; 1.44-MB 3 1/2-inch	1.2-MB 5 1/4-inch; 1.44-MB 3 1/2-inch	1.2-MB 5 1/4-inch; 1.44-MB 3 1/2-inch	1.44-MB 3 1/2-inch
HARD DRIVE CONFIGURATION						
Standard capacity (MB)	Varies	213	130	120	120	210
Brand and model	Varies	Maxtor XT7213AT	Maxtor 7120AT	Conner CP30104H	Lanstar 330 MB	Compaq 210
Interface	IDE	IDE or SCSI	IDE (SCSI opt.)	IDE (SCSI opt.)	SCSI	IDE
Includes caching controller	●	○	●	○	●	○
No. of internal and external drive bays	12	6	8	8	8	3
Range of hard disk capacities available	120 MB to 535 MB	213 MB to 2 GB	80 MB to 1 GB	120 MB to 530 MB	120 MB to 330 MB	60 MB to 210 MB
MONITOR						
Brand	ALR FlexView 3X	CTX 5468NI	Viewsonic 6e	TVM 4A	AAMazing	Compaq
Color (C)/Monochrome (M)	C	C	C	C	C	C
Maximum resolution	1024 x 768	1024 x 768 (noninterlaced)	1024 x 768	1024 x 768 (noninterlaced)	1024 x 768	1024 x 768
Provides dual voltage (115/60Hz-220/50Hz):	●	●	●	●	○	●
EXPANSION SLOTS						
No. of ISA slots	10	8	8	8	6	3
No. of EISA slots	None	None	None	None	None	None
Proprietary slots	Two 32-bit bus slots	One 32-bit local bus video	One 32-bit local bus video	One 32-bit local bus video	None	None
STANDARD INTERFACES						
No. of serial ports	2	2	2	2	2	1
No. of parallel/printer ports	1	1	1	1	1	1
Video adapter/Resolution	SVGA/1024 x 768	SVGA/1280 x 1024	SVGA/1280 x 1024	SVGA/1280 x 1024	SVGA/1024 x 768	SVGA/1024 x 768
Standard VRAM (MB)	1	1	1	1	1	0.5
Brand of video adapter	Western Digital	Orchid Fahrenheit	Diamond Stealth	ALR	Trident	Qvision 1024
Mouse Included	●	●	●	○	●	○
Serial mouse (S)/Mouse port (MP)	MP	S	S	S	S	MP
Game port included	○	●	●	○	○	○
POWER SUPPLY						
Watts	300	230	250	300	250	145
Provides dual voltage (115/60Hz-220/50Hz)	●	●	●	●	●	●
COMPATIBILITY						
MS-DOS 5.0	●	●	●	●	●	●
Windows 3.1	●	●	●	●	●	●
OS/2	●	●	●	●	●	●
NetWare 386	●	●	●	●	●	●
Novell certified	●	○	○	○	○	●
SCO Unix	○	●	○	○	●	○
MPX	○	●	○	○	●	○
Interactive Unix	●	●	●	●	●	○
Other operating systems	Microport Unix	None	AT&T Unix, Xenix, pc/MOS	None	Concurrent DOS	None
BUNDLED SOFTWARE						
MS-DOS 5.0	●	○	●	●	●	●
Windows 3.1	●	○	●	○	○	●
Other	None	None	None	None	None	Utilities
WARRANTY						
	1 year parts and labor; opt. on-site service	1 year parts and labor	30-day money-back; 13 months parts and labor	1 year parts and labor	2 year parts and labor; 1 year on-site service	1 year parts and 1 year on-site service
Technical support	●	●	●	●	●	●
LIST PRICES						
Standard configuration	\$3195	\$2850	\$2080	\$1685	\$3395	\$2549
Review unit	\$3993	\$2850	\$2648	\$2655	\$4595	\$3597
Review unit options	512 KB VRAM, SVGA color monitor, IDE caching disk controller	None	Caching controller, Diamond Stealth SVGA monitor, upgrade to 8 MB RAM, 256-KB cache	Upgrade to 8 MB RAM, 210-MB hard drive, SVGA adapter, mouse and Windows 3.1, tower case	4 MB RAM, 330-MB hard drive, SCSI caching controller, SVGA color monitor, 256-KB cache, SVGA adapter	4 MB RAM, 210-MB hard drive, Compaq monitor

Take a good look at the system's monitor; it can be an expensive item to replace. (● = yes; ○ = no)

CompuAdd Computer Corp. CompuAdd 433	CompuTrend Systems, Inc. Premio 486-33	Daly Computers, Inc. DC486/33C	Dell Computer Corp. Dell 486D/33	DFI, Inc. Diamond Series Model 433D	Duracom Computer Systems DeskSaver 486/33	Everex Systems, Inc. Tempo M Series 486/33
486DX/33; 486DX2/66 ● ● Weitek 4167 OPTI Phoenix	486DX/33; 486DX2/66 ● ● Weitek 4167 Contaq AMI	486DX/33 ● ○ Weitek 4167 OPTI AMI	486DX/33; 486DX2/66 ● ● None VLSI Phoenix	486DX/33; 486DX2/66 ● ● Weitek 4167 UMC AMI	486SX/20 or 25; 486DX/33 or 50; 486DX2/50 or 66 ● ● Weitek 4167 UMC AMI	486DX/33; 486DX2/50 or 66 ● ● Weitek 4167 EG66/67 AMI
4 64 None 64 128	4 32 None 64 256	4 64 None 64 512	4 64 None None None	4 64 None 256 256	4 64 None 128 256	4 32 None 128 256
1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch;	1.44-MB 3½-inch 5¼-inch;
200 Western Digital Caviar IDE ○ 5 40 MB to 660 MB	212 Varies IDE ○ 5 42 MB to 212 MB	212 Conner CP-3200F SCSI ○ 5 200 MB	84 Quantum LPS 84AT IDE ○ 5 120 MB to 500 MB	210 Western Digital IDE ○ 5 Varies	Varies Maxtor IDE (SCSI opt.) ○ 6 80 MB to 545 MB	Varies Varies IDE ○ 5 80 MB to 245 MB
CompuAdd C 1024 x 768 ●	Premio C 1024 x 768 ●	NEC 4FG C 1024 x 768 ○	Dell M 640 x 480 ○	ADI C 1024 x 768 ●	Duracom C 1024 x 768 (noninterlaced) ●	Everex MON500 C 1024 x 768 ●
8 None None	8 None None	8 None None	6 None None	7 None One for 32-bit memory board	8 None One for 32-bit memory board	7 None One for CPU card
2 1 SVGA/1024 x 768 1 CompuAdd ○ S ○	2 1 SVGA/1280 x 1024 1 Paradise ● S ○	2 1 SVGA/1024 x 768 1 ATI 8514 Ultra ● S ○	2 1 SVGA/1024 x 768 1 Western Digital ● MP ○	2 1 SVGA/1024 x 768 Integrated local bus 1 Tseng Labs ET-4000 ● S ●	2 1 SVGA/1024 x 768 Integrated local bus 0.5 Tseng Labs ET-4000 ○ S ●	2 1 SVGA/1280 x 1024 0.5 Integrated Tseng Labs ET-4000 ● S ○
200 ●	230 ●	220 ●	225 ●	200 ●	200 ●	200 ●
● ● ● ● ○ ● ○ ● None	● ● ● ● ○ ● ○ ○ None	● ● ● ● ● ● ● ○ None	● ● ● ● ● ● ○ ○ None	● ● ● ● ○ ● ● ● None	● ● ● ● ○ ● ○ ● Banyan Vines	● ● ● ● ○ ● ○ ○ None
● ● Utilities	○ ○ None	● ○ None	● ● Utilities	● ● None	○ ○ None	● ● None
1 year parts and labor; 1 year on-site service ●	1 year parts and labor; opt. on-site service ●	1 year parts and labor; 1 year on-site service ●	1 year parts and labor ●	1 year parts and labor; 1 year on-site service ●	1 year parts and labor; 1 year on-site service ●	1 year parts and labor; 1 year on-site service ●
\$2355 \$2875 4 MB RAM, 200-MB hard drive, mouse kit	\$1899 \$1899 None	\$1799 \$3475 4 MB RAM, ATI Ultra Graphics card, NEC 4FG monitor, 200-MB SCSI hard drive, SCSI controller	\$2199 \$3019 4 MB RAM, 230-MB hard drive, SVGA color monitor, 1.44-MB floppy drive	\$2495 \$3659 4 MB RAM, 210-MB hard drive, SVGA color monitor	\$1299 \$2495 4 MB RAM, 1.44-MB floppy drive, 256-KB cache, MS-DOS 5.0, Windows 3.1, mouse, SVGA color monitor, 200-MB hard drive, 1 MB VRAM	\$1869 \$2499 4 MB RAM, 200-MB hard drive, SVGA color monitor

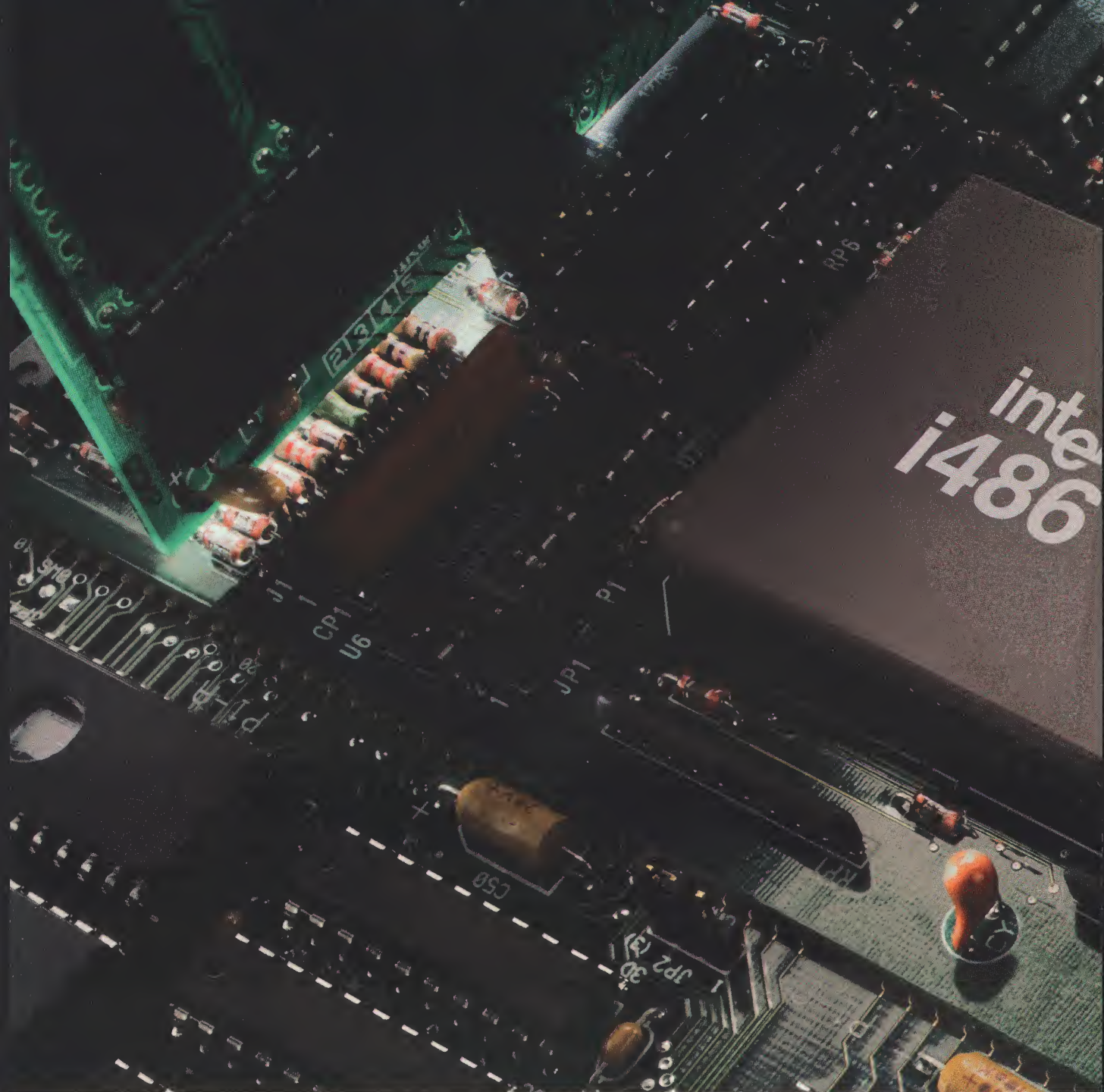
continued

(● = yes; ○ = no)

COMPANY Model	Gateway 2000, Inc. 486DX/33	Insight Distribution Network, Inc. Insight 486-33 Cache	Lodestar Computer 486 LB Data Master	NEC Technologies, Inc. PowerMate 486/33i	Northgate Computer Systems, Inc. Elegance ZXP	Packard Bell PB 486DX/33
CHIPS						
Processors supported (chip/speed)	486DX/33	486DX/33; 486DX2/66	486SX/20 and 25; 486DX/25, 33, and 50; 486DX2/50 and 66	486DX/33; 486DX2/50 and 66	486SX/20 and 25; 486DX/25 and 33; 486DX2/50 and 66	486DX/33; 486DX2/66
Uses cache	●	●	●	●	●	●
CPU upgrade available	○	●	●	●	● (ZIF socket)	●
External coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	None	Weitek 4167	None
Brand of motherboard chip set	Intel	OPTI	UMC	OPTI	OPTI	Intel
Brand of BIOS	Phoenix	AMI	AMI	Phoenix	Northgate	Phoenix
MEMORY						
Standard RAM (MB)	4	4	4	4	4	4
Maximum RAM (MB)	32	32	32	36	32	20
No. of wait states	None	None	None	None	None	None
Standard cache (KB)	None	64	64	None	64	None
Maximum cache (KB)	None	256	256	128	256	256
STORAGE MEDIA						
Standard floppy configuration						
Drives and types	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch
HARD DRIVE CONFIGURATION						
Standard capacity (MB)	200	213	120	120	240	130
Brand and model	Western Digital Caviar	Western Digital	Maxtor XT7120A	Quantum Prodrive	Seagate	Seagate ST314
Interface	IDE (SCSI opt.)	IDE	IDE (SCSI opt.)	IDE	IDE	IDE
Includes caching controller	●	●	●	○	○	○
No. of internal and external drive bays	2	8	6	4	5	4
Range of hard disk capacities available	80 MB to 1.2 GB	40 MB to 4 GB	42 MB to 1.2 GB	120 MB and 240 MB	40 MB to 1.5 GB	130 MB to 400 MB
MONITOR						
Brand	CrystalScan	Viewsonic or TVM	StarView 2000	None	Panasonic	Packard Bell
Color (C)/Monochrome (M)	C	C	C	None	C	C
Maximum resolution	1024 x 768	1024 x 768	1024 x 768	None	1024 x 768	1024 x 768
Provides dual voltage (115/60Hz-220/50Hz):	●	No, Viewsonic; yes, TVM	●	○	○	●
EXPANSION SLOTS						
No. of ISA slots	8	8	6	4	7	4
No. of EISA slots	None	None	None	None	None	None
Proprietary slots	None	None	Two 32-bit local bus slots	None	None	None
STANDARD INTERFACES						
No. of serial ports	2	2	2	1	2	1
No. of parallel/printer ports	1	1	1	1	1	1
Video adapter/Resolution	SVGA/1024 x 768	SVGA/1280 x 1024	SVGA/1280 x 1024	SVGA/1280 x 1024	SVGA/1024 x 768	SVGA/1024 x 768
Standard VRAM (MB)	1	1	1	1	1	0.5
Brand of video adapter	ATI Graphics Ultra	Diamond Speedstar	Lodestar local bus SVGA	Tseng Labs ET-4000	STB Ergo	Oak Tech. OTI-C
Mouse included	●	●	●	●	●	●
Serial mouse (S)/Mouse port (MP)	S	S	S	MP	S	S
Game port included	○	○	●	○	○	●
POWER SUPPLY						
Watts	200	250	230	110	220	150
Provides dual voltage (115/60Hz-220/50Hz)	●	●	●	●	●	●
COMPATIBILITY						
MS-DOS 5.0	●	●	●	●	●	●
Windows 3.1	●	●	●	●	●	○
OS/2	●	●	●	●	●	○
NetWare 386	○	●	●	●	●	●
Novell certified	○	○	●	●	○	●
SCO Unix	●	●	●	●	●	○
MPX	○	○	●	○	○	○
Interactive Unix	○	●	●	○	●	○
Other operating systems	None	None	None	None	DR DOS 6.0	None
BUNDLED SOFTWARE						
MS-DOS 5.0	●	○	●	●	●	●
Windows 3.1	●	○	●	●	●	●
Other	Choice of one of seven applications	None	None	None	Diagnostic utilities	Utilities, tutorial, Lotus Write, Lotus 1-2-3 for Windows
WARRANTY						
	30-day money-back; 1 year parts and labor; 90-day limited upgrade policy	30-day money-back; 1 year parts and labor	30-day money-back; 2 year parts and lifetime labor; 1 year on-site service	1 year parts and labor; 1 year on-site service	30-day money-back; 1 year parts and labor	1 year parts and labor; 1 year on-site service
Technical support	●	●	●	●	●	●
LIST PRICES						
Standard configuration	\$2395	\$1999	\$1979	\$2099	\$1999	OEM pricing
Review unit	\$2682	\$3069	\$2599	\$3098	\$2919	Approx. \$2200
Review unit options	4 MB RAM	4 MB RAM, SVGA color monitor, 213-MB hard drive, caching hard drive controller	256-KB cache, 4 MB RAM, 210-MB hard drive, SVGA color monitor, programmable keyboard, 2-MB cache RAM	240-MB hard drive, 4 MB RAM	4 MB RAM, 240-MB hard drive, SVGA color monitor, Omnikey keyboard	4 MB RAM

Polywell Computers, Inc. Poly 486/33VF	QSI Corp. Klonimus 486/33	Tandy Corp. Tandy 4833 LX/T	Tangent Computer, Inc. Tangent Model 433i	Tri-Star Computer Corp. Tri-WIN 486DX/33 EISA	Uniq Tech, Inc. UTI 486DX-33	Wyse Technology, Inc. Decision 486si
486DX/33; 486DX2/66 ● ● Weitek 4167 OPTI AMI	486DX/33 ● ○ Weitek 4167 Contaq AMI	486DX/33; 486DX2/66 ● ● None VLSI/Topcat Phoenix	486DX/33; 486DX2/66 ● ● Weitek 4167 SIS AMI	486DX/33; 486DX2/66 ● ● Weitek 4167 Intel AMI	486DX/33; 486DX2/66 ● ● Weitek 4167 OPTI AMI	486SX/16, 20 and 25; 486DX/20, 25 and 33; 486DX2/50 and 66 ● (ZIF socket) Weitek 4167 OPTI Phoenix
4 32 None 64 256	8 32 None 64 256	4 64 None None None	4 64 None 128 256	8 64 None 256 256	4 32 None 64 256	4 64 None 8 256
1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.44-MB 3½-inch	1.2-MB 5¼-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch	1.2-MB 5¼-inch; 1.44-MB 3½-inch
120 Maxtor XT7120A IDE (SCSI opt.) ● 8 130 MB to 2.5 GB	80 Varies IDE ○ 6 40 MB to 4 GB	Varies Varies IDE ● 4 40 MB to 440 MB	100 HP hpc2233 IDE ○ 5 100 MB to 510 MB	384 Maxtor LXT2135 SCSI ● 8 210 MB to 1.2 GB	80 Conner CP2084E IDE ○ 4 80 MB to 1.2 GB	120 Quantum, Maxtor, or Seagate IDE ○ 5 120 MB and 200 MB
Viewsonic 4e C 1024 x 768 ●	CTX 5468A C 1024 x 768 ●	Tandy VGM 441 C 1024 x 768 ○	Relisys C 1024 x 768 (noninterlaced) ○	MAG MX14H C 1280 x 1024 ●	Axon C 1024 x 768 ○	Wyse WY-670 C 1024 x 768 ●
8 None None	8 None None	7 None None	8 None One for 32-bit memory board	2 6 None	8 None None	6 None None
2 1 SVGA/1024 x 768 1 Trident ○ S ●	2 1 SVGA/1024 x 768 1 STB ● S ●	2 1 SVGA/1024 x 768 0.5 Western Digital ○ MP ○	2 1 SVGA/1024 x 768 1 Diamond ● S ●	2 1 SVGA/1280 x 1024 1 Diamond Speedstar Plus HiColor ● S ●	2 1 SVGA/1024 x 768 1 ATI ● S ●	2 1 SVGA/1024 x 768 Integrated local bus 0.5 Wyse Hyper16 ○ MP ○
250 ●	200 ●	300 ●	300 ●	230 ●	220 ●	200 ●
● ● ● ● ○ ● ○ ● None	● ● ● ● ○ ● ○ ● None	● ● ● ● ● ● ○ ● None	● ● ● ● ○ ● ○ ○ None	● ● ● ● ○ ● ○ ○ None	● ● ● ● ○ ● ● ● None	● ● ● ● ○ ● ○ ○ USL Unix Banyan Vines
○ ○ None	○ ○ None	● ● None	● ● OS/2 (opt.)	○ ○ AutoCAD tutorial	● ● None	● ● None
30-day money-back; opt. 1 year on-site service; 2 years parts and 5 years labor ●	1 year parts and labor; 1 year on-site service ●	1 year parts and labor ●	1 year parts and labor; 1 year on-site service ●	2 year parts and lifetime labor; 1 year on-site service ●	1 year parts and labor; 1 year on-site service ●	1 year parts and labor; opt. 1 year on-site service ●
\$1880 \$3475 6 MB RAM, 240-MB SCSI hard drive, caching controller, 250-MB tape drive	\$2128 \$2840 340-MB hard drive, SVGA color monitor	\$3299 \$4998 SVGA color monitor, 240-MB hard drive, upgrade to 8 MB RAM	\$2595 \$2945 4MB RAM, 128 KB cache RAM	\$3695 \$3135 Equip. downgrade: 210-MB hard drive, caching controller, SVGA board	\$1989 \$2469 4 MB RAM, 200-MB hard drive	\$1709 \$2928 CPU upgrade, 4 MB RAM, 200-MB hard drive, SVGA color monitor

continued



Shift all of your sof

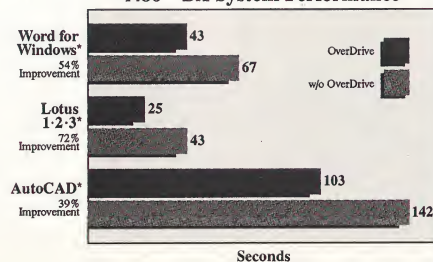
Introducing Intel OverDrive™ Processors for your i486™ DX PC.

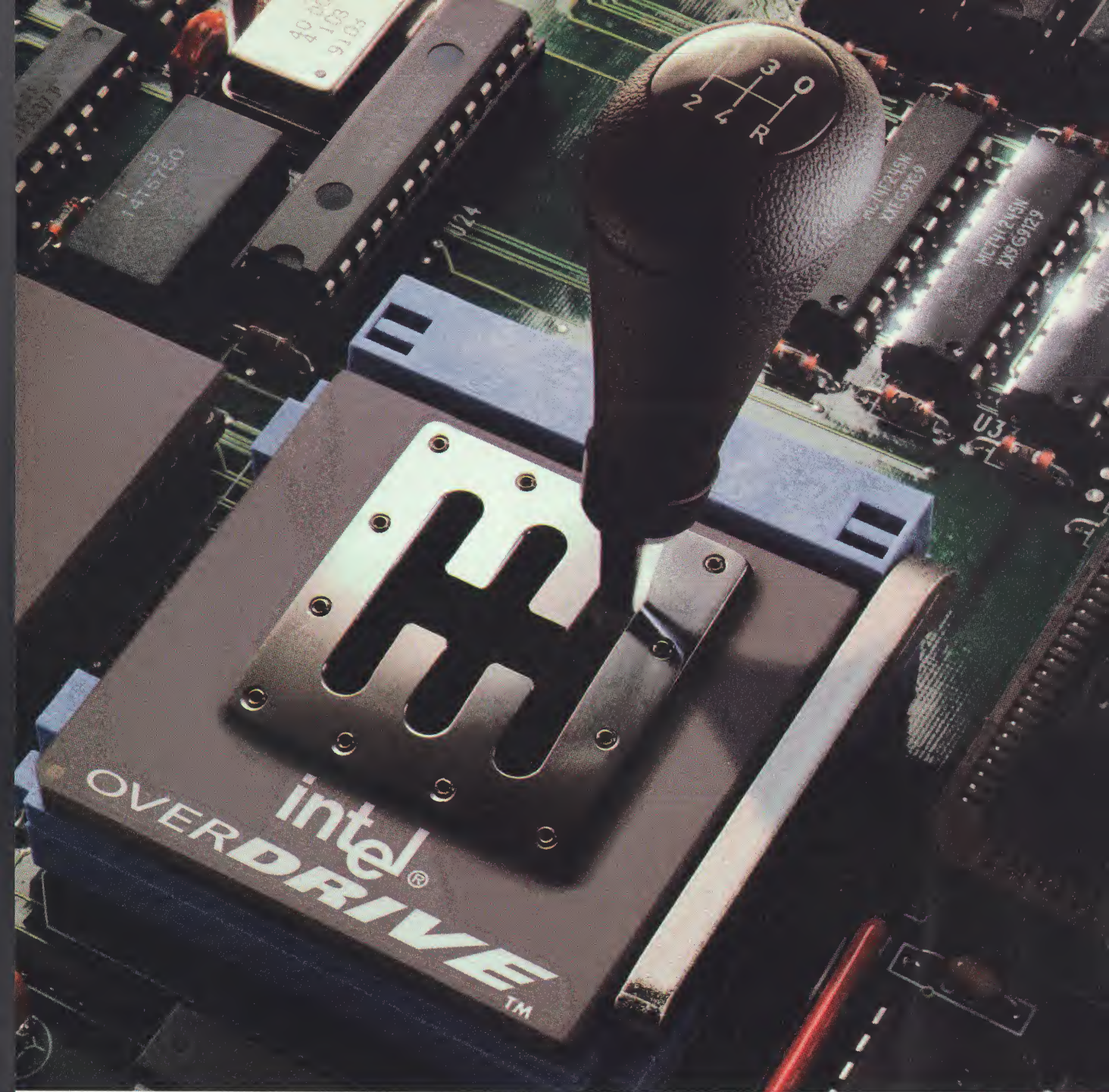
Would you like to visibly increase the speed of all your applications? Then it's time you shift your i486 DX or SX system into OverDrive.

Using Intel's ingenious "speed doubling" technology, an OverDrive Processor gives you plenty of added power—up to a 70% performance boost systemwide.

And that power will benefit every application you run on DOS, OS/2*, Windows*, or UNIX*—from

i486™ DX System Performance





ware into overdrive.

AutoCAD* to WordPerfect* and over 50,000 applications in between.

It's easy to install an OverDrive Processor. Just plug the single-chip upgrade into the vacant OverDrive socket† and you're

**WE MAKE
COMPUTERS
WORK
HARDER.**

Find out more. Ask for ext. 228
1-800-538-3373

ready to go. Faster.

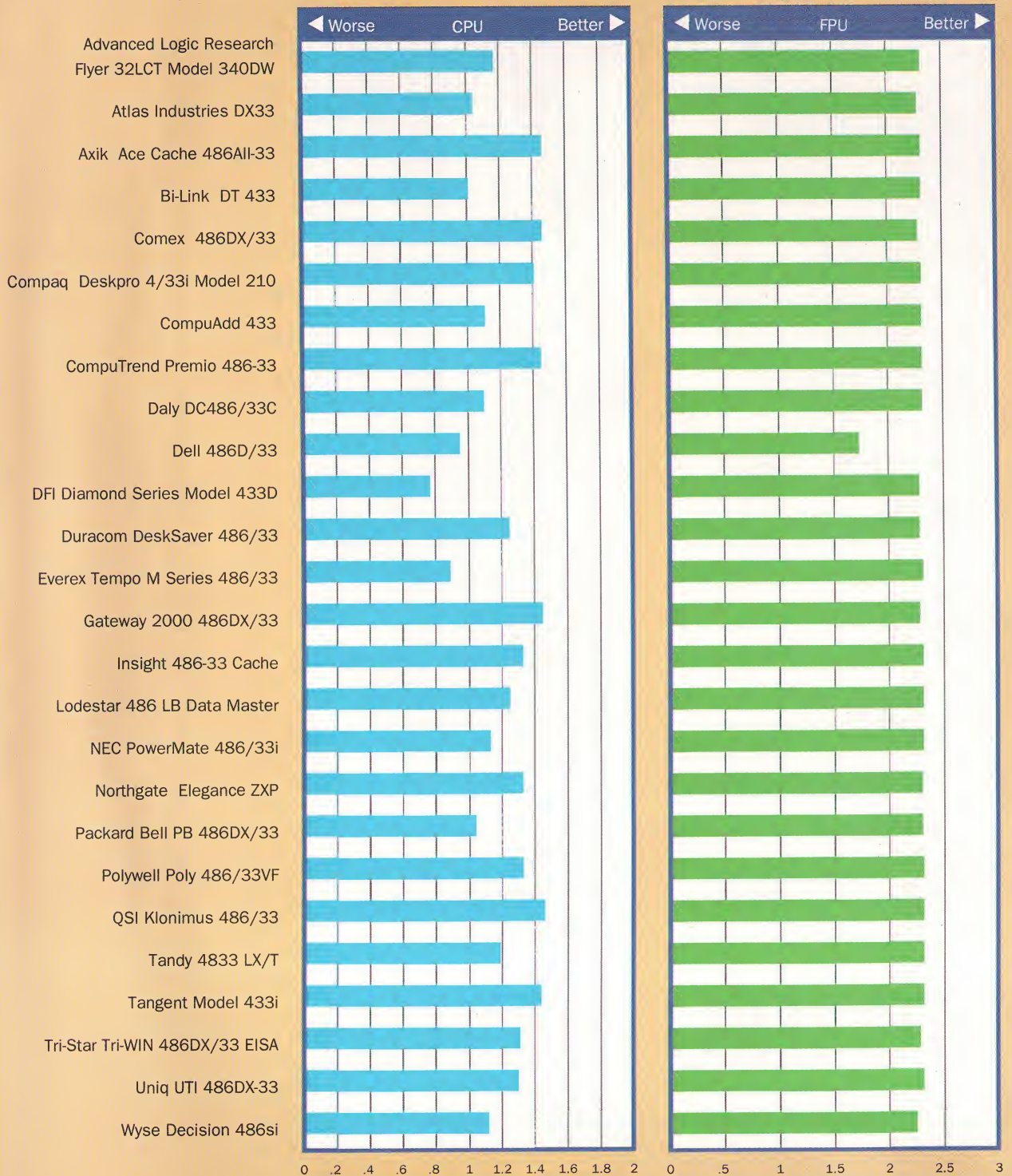
So to rev up your i486 system and keep up to speed on all the latest software developments, you need the future of PC upgradability: Intel

OverDrive Processors.

Call 1-800-538-3373, ext. 228 for more information. Because when it comes to running software, there's only one gear. High.

intel®

BYTE LOW-LEVEL BENCHMARKS



The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990. Version 2.2 of the BYTE low-level benchmarks is available in the byte.bmarks

conference on BIX, or you can contact BYTE directly. All results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Compaq Deskpro 386/33L running Compaq DOS 5.0 and Windows 3.0 is assigned a value of 1. For each index in the Unix tests, the performance of a Sun Sparcstation IPC is assigned a value of 1. The overall index is the average of all tests.

continued

LAUNCH YOUR HARD DRIVE!

*Promise
Introduces
the First
Truly
Affordable
Caching Disk
Controllers.*

Prices Start at \$129.00

Order an IDE Caching Controller today and watch your system operate at light speed!

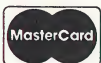
Featuring

- .3ms Average Disk Access Speed.
- "Plug and Play" Operation.
- Easy to Follow Documentation.
- Two Year Warranty.
- Guaranteed to Run with All Operating Systems & Applications Software.

Our new ultra-low cost disk accelerators will finally end the data bottleneck that takes up so much of your valuable time and at a fraction of the cost of similar cache controllers. They install in minutes and require no special tools or expertise. Satisfaction guaranteed!

“ If you're tired of watching your hard drive slowly give up its data, Promise Technology may be able to put the spring back into your data handling... There are other caching IDE controllers available, but they don't share the flexibility and simplicity of the DC-2032. These two attributes will make it a sterling addition to your computer. ”
Bill O'Brien, PC Sources.

“ ★★★★★ An enormous improvement in performance was immediately obvious compared to the un-cached controller . . . Overall, this controller increased performance by a factor of around 8 times when using large database applications. At a more general level, the whole machine seemed faster and more responsive . . . At the new lower price, this is an extremely good value and extra features make this controller (DC-2031) a particularly attractive option. ”
Dave Pearman, PC+ (U.K.) March '92



**OEM and Dealer
Inquiries Welcome.**

ITALY:
Executive di Ascoli
(39) 0341-282614

GERMANY:
CPS
(49) 040-656-998-0

U.K.:
Dan Technology
(44) 081-902-9922

FRANCE:
HTS
(33) 042-20-59-59

SPAIN:
Mega Micro
(34) 01 571 42 75

DENMARK:
Dancotek
(45) 044 44 03 22

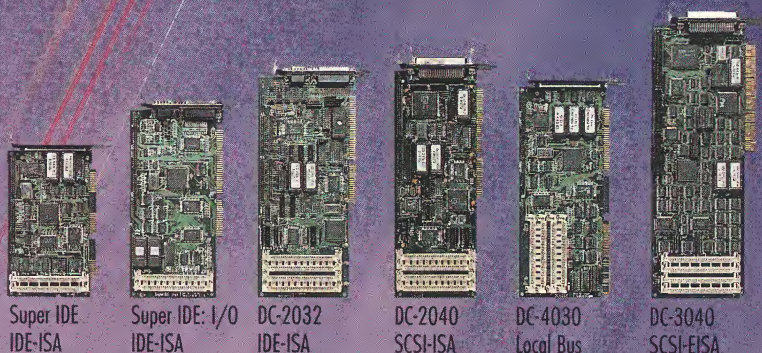
◆ **VL-BUS
NOW
AVAILABLE!** ◆

**Toll Free in USA
1-800-888-0245**

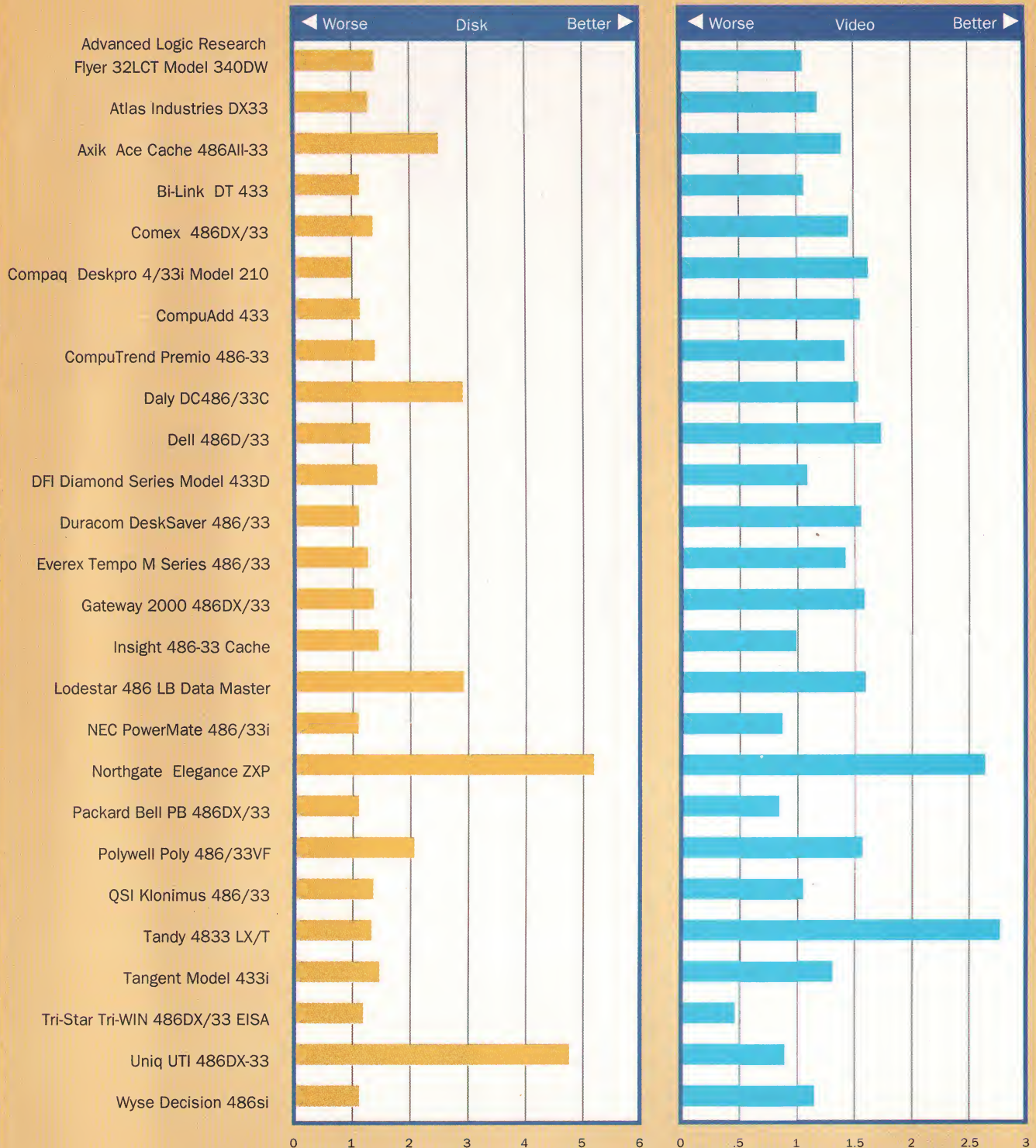
Hard drive depicted is the Maxtor LXT535 IDE drive.
Provided courtesy of Maxtor Corporation.

**PROMISE
TECHNOLOGY, INC.**

1460 Koll Circle, San Jose, CA 95112
Tel. (408) 452-0948 Fax (408) 452-1534



BYTE LOW-LEVEL BENCHMARKS



The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990. Version 2.2 of the BYTE low-level benchmarks is available in the byte.bmarks

conference on BIX, or you can contact BYTE directly. All results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Compaq Deskpro 386/33L running Compaq DOS 5.0 and Windows 3.0 is assigned a value of 1. For each index in the Unix tests, the performance of a Sun Sparcstation IPC is assigned a value of 1. The overall index is the average of all tests.

continued

A monitor touched by Michelangelo

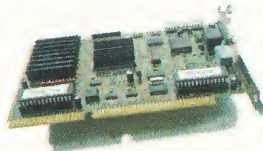
Buy an IOcomm ThinkSync 7A 17" color monitor with a Michelangelo VRAM 1280 Graphics Accelerator and you've got a graphics subsystem that delivers unmatched performance for large screen, high resolution users (up to 1280 x 1024 non-interlaced resolution). All for the unbeatable price of **\$1295***.

Ideal for CAD, Desktop Publishing, Windows.

Michelangelo's 1280 x 1024 non-interlaced resolution coupled with the monitor's .26 dot pitch gives CAD users crisp, stable definition, even on hairlines.

Graphic designers and desktop publishers appreciate the larger, distortion-free flat image area that allows edge-to-edge graphics, and redraws them with lightning speed. Windows users go for the rock-solid, flicker-free image made possible by refresh rates up to 72Hz, and *all that color*—32,768 colors in low-resolution; 256 in high resolution modes.

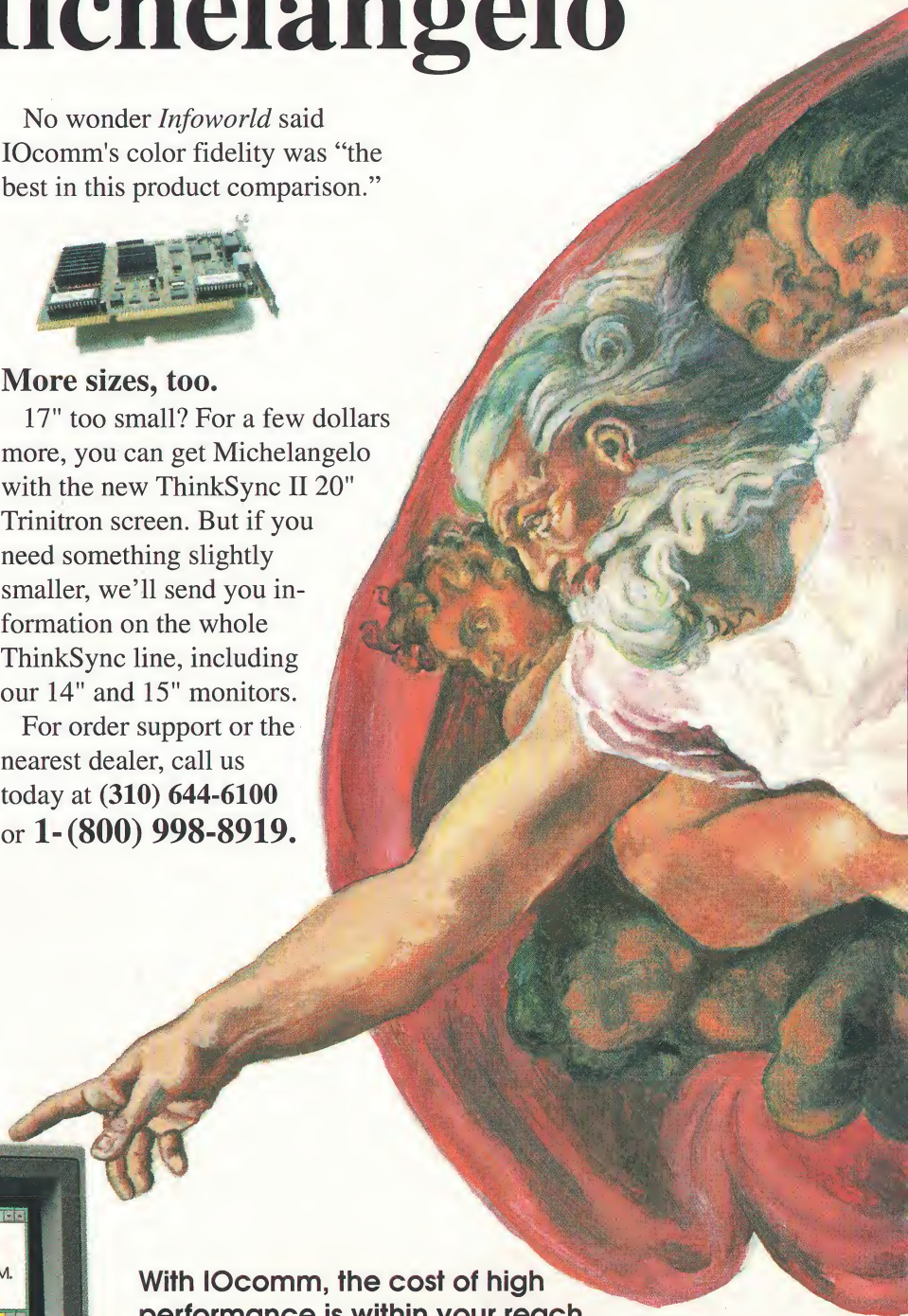
No wonder *Infoworld* said IOcomm's color fidelity was "the best in this product comparison."



More sizes, too.

17" too small? For a few dollars more, you can get Michelangelo with the new ThinkSync II 20" Trinitron screen. But if you need something slightly smaller, we'll send you information on the whole ThinkSync line, including our 14" and 15" monitors.

For order support or the nearest dealer, call us today at **(310) 644-6100** or **1-(800) 998-8919**.



With IOcomm, the cost of high performance is within your reach.



12700 Yukon Avenue
Hawthorne, CA 90250
(310) 644-6100 Fax (310) 644-6068
1-(800) 998-8919

*Limited time only (MSRP \$1545)

© Copyright 1992, IOcomm. Specifications may change without notice. All brands and names mentioned are registered trademarks of their owners.

1-800-8

Your Natural Resource



Keyboards



- 8088/286/386/486 compatible
- Automatically switch between XT or AT.
- One-year warranty

NB17128

Part No.	Product No.	Description	Price
NB17128	FKB4700	Fujitsu 101-key enhanced keyboard	\$79.95
NB17136	FK5001	130-key enhanced keyboard with calculator.....	99.95
NB20474	JE2018	32-key serial keypad	59.95
NB67432	K101	101-key enhanced keyboard (90-day warranty).....	49.95

Power Supplies

- One-year warranty



NB19465

Part No.	Product No.	Description	Price
NB19465	JE1030	150 watt 8088.....	\$69.95
NB67467	JE1030A	200 watt 8088	89.95
NB19545	JE1036	200 watt 286/386/486.....	89.95
NB19570	JE1038A	250 watt 286/386/486.....	99.95
NB65728	JE1039A	300 watt 286/386/486.....	149.95

KaLok Hard Disk Drives

- 90-day warranty

Part No.	Product No.	Description	Price
NB22322	KL320	20MB MFM hard drive.....	\$169.95
NB22331	KL330	30MB RLL hard drive.....	189.95

Call for information on controller cards.

Hard Drives (IDE)

Conner IDE

- 8088/286/386/486 compatible
- Requires host IDE adapter
- One-year warranty



Part No.	Product No.	Capacity	Speed	Price
NB14058	CP3000	40MB	25ms.....	\$249.95
NB14066	CP30084	80MB	25ms.....	359.95
NB14074	CP30104	120MB	19ms.....	429.95
NB14120	CP3204	200MB	16ms.....	699.95

Controllers IDE Disk Drive Adapter Cards

- Interfaces two IDE hard drives to system
- One-year warranty



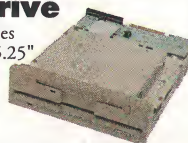
NB10268

Part No.	Product No.	Description	Price
NB10233	ADP20	16-bit hard adapter.....	\$29.95
NB10250	ADP20F	16-bit hard/floppy adapter.....	39.95
NB10268	ADP50	8-bit hard adapter.....	79.95
NB10276	ADP60	16-bit hard adapter with BIOS.....	79.95
NB10284	ADP60F	16-bit hard/floppy adapter with BIOS.....	99.95
NB74114	ADP65F	Quad floppy controller/IDE	129.95

TEAC Combination Disk Drive

- IBM PC/XT/AT and compatibles
- 3.5" and 5.25" disk drives in a 5.25" half height drive bay

3.5" Disk Formats
• 1.44MB • 720KB
5.25" Disk Formats
• 1.2MB • 360KB • One-year warranty



Part No.	Price
NB74392	\$229.95

TEAC 3.5" 2.88MB Disk Drive

- IBM PC/XT/AT and compatibles
- 2.88MB/1.44MB/720KB compatible
- One-year warranty

Part No.	Price
NB74384	\$149.95

Jameco Power Base

- Masterpower switch and 5 auxillary switches for each outlet
- 15A, 125 VAC, 1875 watts, 60Hz
- Maximum spike: 80 joules one time
- Maximum spike volts: 6,000V
- Clamping response time: 10ns
- Color: beige



Part No.	Product No.	Price
NB20159	JE1190.....	\$29.95

Six-Outlet Power Strip

- Built-in safety circuit breaker (15 amps)
- Master switch with pilot light
- Three-prong, 6-foot power cord
- UL listed

Part No.	Product No.	Price
NB20175	JE1191.....	\$11.95

Floppy Disk Drives

Toshiba 1.44MB 3.5" Internal Floppy Disk Drive

- 8088/286/386/486 compatible*
- One-year warranty

Part No.	Product No.	Price
NB40774	356KU.....	\$99.95

*Requires JE1043 or JE1049 floppy controllers for 8088 machines.

Additional Internal Floppy Disk Drives

Part No.	Product No.	Description	Price
NB17099	FD55B	5.25" TEAC 360KB.....	\$89.95
NB17101	FD55G	5.25" TEAC 1.2MB.....	99.95

Floppy Controllers

- One-year warranty

Part No.	Product No.	Description	Price
NB19617	JE1043	88/286/386/486 two-drive	\$49.95
NB19668	JE1049	88/286/386/486 four-drive..	59.95

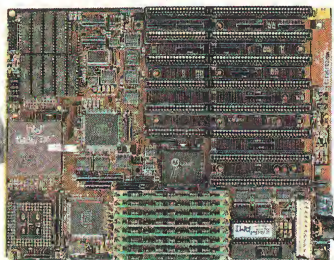
31•4242

Only A Phone Call Away



**Announcing
JAMECO
ServiceLine™**
Computer Repair
and Support
1-800-831-8020

80386/80486 Motherboards



• One-year warranty

Part No.	Description	RAM	Price
NB75619	80386DX 33Mhz	2MB	\$489.95
NB75627	80386DX 40Mhz	4MB	\$585.95
NB75635	80486DX 33Mhz	8MB	\$1,009.95
NB75643	80486DX 50Mhz	8MB	\$1,639.95
NB75651	80486DX 50Mhz	16MB	\$2,749.95

Additional Jameco Motherboards

• One-year warranty
• RAM not included

Part No.	Product No.	Description	Price
NB53882	JE3616SN	80386SX 16MHz motherboard	\$209.95
NB20941	JE3006	80286 12MHz motherboard	\$124.95
NB67521	JE1002BE	8088 10MHz motherboard	\$69.95

Call for additional software options and information on our 386 and 486 computer kits!

Memory



Expand your memory. See our excellent selection at low prices for all types of RAM. Jameco also offers memory modules for Apple, AST, Compaq, Epson, IBM, Hewlett-Packard and Toshiba computers.

DIP

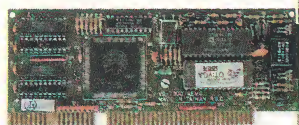
Part No.	Product No.	Pins	Function	Price
NB41398	41256-120	16	256K 120ns	\$1.69
NB41427	41256-150	16	256K 150ns	\$1.59
NB42251	511000P-80	18	1MB 80ns	\$5.99
NB42219	511000P-10	18	1MB 100ns	\$5.49

SIPPs and SIMMs

NB41451	41256A9A-10	256K SIPP	100ns	\$18.95
NB41523	41256A9B-80	256K SIMM	80ns	\$16.95
NB41718	421000A9A-80	1MB SIPP	80ns	\$54.95

Call for additional information on our selection of math coprocessors.

Computer Cards



16-bit VGA Card

- 8088/286/386 compatible
- Comes with 256KB video RAM expandable to 512KB
- Capable of 640 x 480 with 256 colors, 800 x 600 with 256 colors, 1024 x 768 with 16 colors (512KB RAM required for all modes)
- One-year warranty

Part No.	Product No.	Price
NB67459	VG7700	\$99.95

Additional Cards

Part No.	Product No.	Function	Price
NB19596	JE1040	8088 floppy controller	\$19.95
NB19705	JE1050A	8088/286/386/486 monochrome graphics adapter	\$49.95
NB19781	JE1058S	8088/286/386/486 Super VGA	\$159.95
NB19801	JE1060	8088 I/O	\$59.95
NB19828	JE1062	8088/286/386/486 RS232 serial (16450 UART)	\$29.95
NB67053	JE1062A	8088/286/386/486 RS232 serial (16550 UART)	\$39.95
NB19844	JE1065	80286/386/486 I/O	\$49.95
NB19895	JE1075	8088 multi I/O w/floppy controller	\$69.95
NB19908	JE1076	80286/386/486 multi I/O w/floppy controller	\$69.95
NB19975	JE1080	8088 memory expansion half card	\$49.95
NB29313	RAMQUEST	8088/286/386/486 Orchid 32MB memory card	\$154.95

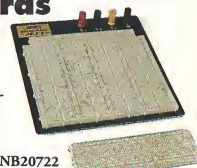
Cables, Gender Changers, and Adapters



Part No.	Product No.	Description	Price
NB28716	PPC6	6-foot parallel DB25-pin male to Centronics male printer cable	\$7.95
NB28708	PPC12	12-foot parallel DB25-pin male to Centronics male printer cable	\$10.95
NB31721	SAT6	6-foot 9-pin serial DE9 female to DB25 male cable	\$5.95
NB39511	25M10F	10-foot DB25-pin male to female cable extension	\$9.95
NB39538	25M10M	10-foot DB25-pin male to male cable extension	\$9.95
NB18420	GC25F	DB25-pin female slim line gender changer	\$4.49
NB18446	GC25M	DB25-pin male slim line gender changer	\$4.49
NB10305	AD925	DE9 female to DB25 male serial adapter	\$4.95
NB10321	AD926	DE9 male to DB25 female serial adapter	\$4.95

Jameco Solderless Breadboards

NB20811



Jameco's long-lasting breadboards feature screen-printed color coordinates and are suitable for many kinds of prototyping and circuit design. Larger models feature a heavy-duty aluminum backing with voltage and grounding posts.

Part No.	Product No.	Dim. L" x W"	Contact Points	Binding Posts	Price
NB20600	JE21	3.25 x 2.125	400	0	\$4.95
NB20722	JE23	6.50 x 2.125	830	0	\$6.95
NB20757	JE24	6.50 x 3.125	1,360	2	\$12.95
NB20773	JE25	6.500 x 4.25	1,660	3	\$17.95
NB20790	JE26	6.875 x 5.75	2,390	4	\$24.95
NB20811	JE27	7.250 x 7.50	3,220	4	\$32.95

Metex Digital Multimeters

- Handheld, high accuracy
- Measures AC/DC voltage, AC/DC current, resistance, diodes, continuity, and transistor current gain (except 27140)
- Manual ranging w/overload protection
- Comes with probes, batteries, case and manual



NB27086 & NB27158 only:

- Also measures frequency and capacitance

Part No.	Product No.	Description	Price
NB27115	M3800	3.5 digit multimeter	\$39.95
NB27078	M3610	3.5 digit multimeter	\$59.95
NB27140	M3900	3.5 digit multimeter with tach/dwell	\$59.95
NB27086	M3650	3.5 digit multimeter w/frequency & capacitance	\$74.95
NB27158	M4650	4.5 digit w/frequency & capacitance & data hold switch	\$99.95

JAMECO™

ELECTRONIC COMPONENTS

COMPUTER PRODUCTS

1355 Shoreway Road, Belmont, CA 94002

Sales: 1-800-831-4242

Outside US: 415-592-8097

FAX: 1-800-237-6948

Jameco ServiceLine™: 1-800-831-8020

Technical Support: 1-800-831-0084



Over 800
NEW items!



GET A FREE JAMECO CATALOG

CALL 1-800-637-8471

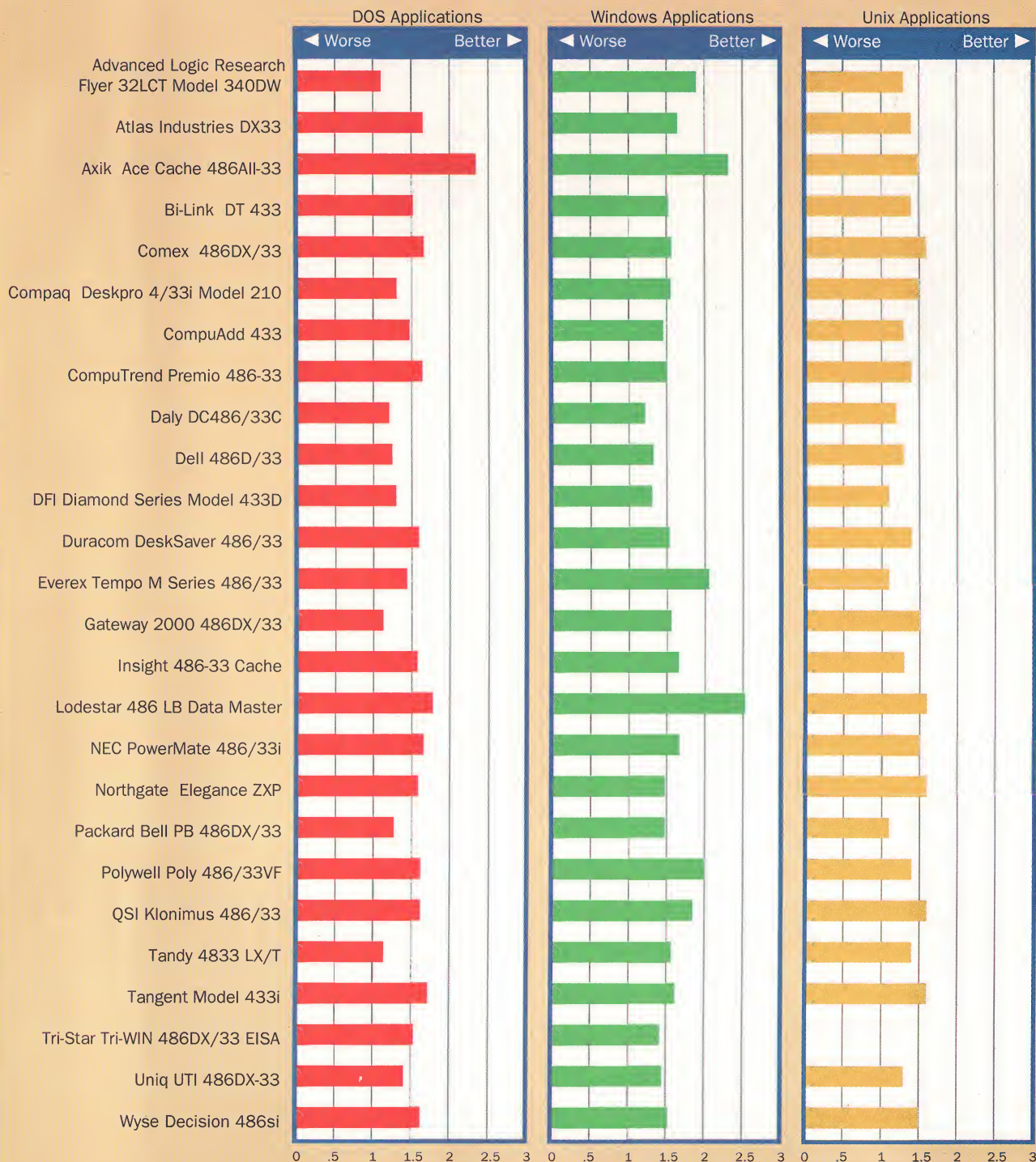
MENTION MAIL KEY NB2

11/92 Jameco Electronic Components/Computer Products All trademarks are registered trademarks of their respective companies.

Terms: Prices are subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.

Circle 65 on Inquiry Card

BYTE SYSTEM BENCHMARKS



BYTE's applications performance suite measures the performance you can expect to achieve running a given applications category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.1. We test six applications categories for each environment, running test scripts with the programs listed in the following software categories: Word Processing (WordPerfect 5.1 and Lotus Ami Pro 2.0); Spreadsheet (Lotus 1-2-3 release 3.1+ and Microsoft Excel 3.0a); Database (Software Publishing Superbase 4 1.3 and Borland dBase IV); Development (Borland Turbo Pascal for Windows and Microsoft C 6.0); Scientific/Engineering (MathSoft

MathCAD for Windows 3.0, The MathWorks MathLab 3.5k, and Computing Resource Center Biturbo Stata 2.1); CAD (Autodesk AutoCAD release 11); Desktop Publishing (Aldus PageMaker 4.0). The data files and test scripts are available from BYTE.

Our Unix tests show relative performance for double-precision arithmetic, the Dhrystone 2 benchmark, spawning a process (exec1()), file-copy throughput, pipe-based context switching, and running a shell script with eight concurrent scripts running. Unix benchmarks are available on Usenet, in the listings area on BIX, or on disk.

continued

Why do they call it a dongle?



He wasn't famous. He didn't drive a fancy car, but dressed in his favorite Comdex T-shirt and faded blue jeans, he set out to change the course of the computer software industry. Quite a task for a lonely software developer.

Sitting in front of his computer, drinking pots of coffee and smoking cartons of cigarettes, he'd write pages of code.

It took time. Years in fact. But he did it. He wrote the most powerful computer program in the world. Now came the hard part. Selling it.

The Most Powerful Program in the World

Determined to make those long years pay off, he called on every distributor, VAR and dealer in the world. He drove from Beantown to San Diego. Flew from Dublin to Borneo. Everyone loved the program.

So he sold a few. Only a few.

Back in Boston he waited. After a long year

with only 13 orders he set out to see what happened. As he drove across the



country and flew around the world he

discovered everyone knew about his program. Everyone had it too.

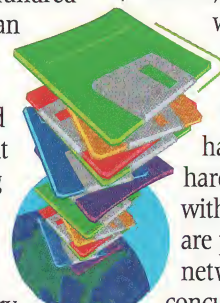
The Global Marketplace

From Paris to Prague, his program was everywhere in Europe. When he got off the plane in Hong Kong he found his program stacked to the ceiling in every computer store. Amazed in disbelief, he bought a hundred cartons of cigarettes and a hundred pounds of Indonesian coffee and flew back to Boston.

Beaten, battered and bruised he went back to the drawing board. This time he would really change the face of the software industry. He would develop a device that would prevent unauthorized distribution of software programs.

Call It What You Like

He developed a hardware key. His peers applauded his efforts. Finally, a solid solution for revenue protection.



But he didn't know what to call it. He thought of naming it after an exotic place he visited in his travels. Madagascar was a bit too long, though.

"Name it after you, Don!", urged his peers. So he did. Soon everyone was calling the key a dongle, after Don Gall — the lonely software developer who did what he had to do.

You've Come A Long Way, Baby

Today, dongles are different. Fact is, they've come a long way. Leading the industry with security solutions, Rainbow Technologies has changed the face of hardware keys. They work with multiple applications, are programmable and network versions control concurrent usage. And they're always transparent to the end-user.

Sentinel Family from Rainbow

Truth is, more and more developers are using keys. And the Sentinel Family is the most widely used in the world. In fact, over 6,000

developers use Sentinel from Rainbow. Why? They are simply the most effective, reliable and easy to implement keys on the market.

Learn more about securing

your software and how keys provide developers with extra value.

Call for a free copy of "The Sentinel Guide to Securing Software." And see just how easy it is to

install a hardware key into your application in just minutes. Try it with our low cost Sentinel Evaluation Kit.

Order one for your DOS, OS/2, Windows, Macintosh or UNIX based application.

And remember, when you need a dongle, you need Sentinel — the only dongle Don Gall would use.

European Headquarters
44 0932-570066

Pacific Rim/Latin America Headquarters
714/ 454-2100

Distributors located worldwide.
Call for a distributor near you.

SENTINEL
Securing the future of software

Some call it a dongle. Those who know, call it Sentinel.



NORTHERN EUROPE

4 The Forum, Hanworth Lane
Chertsey, Surrey, KT16 9JX, United Kingdom
tel: 44 0932-570066 ■ fax: 44 0932-570743

CENTRAL EUROPE

Oskar-Messter-Strasse 16
Postfach 1243, D-8045 Ismaning, Germany
tel: 49 089-961 3051 ■ fax: 49 089-961 2617

SOUTHERN EUROPE

2 Allée des Aulnes
78190 Trappes, France
tel: 33 1 3050 4411 ■ fax: 33 1 3050 6276

PACIFIC RIM/LATIN AMERICA

9292 Jeronimo Road
Irvine, California 92718
tel: 714/ 454-2100 ■ fax: 714/ 454-8557

CALL FOR YOUR FREE GUIDE TO SECURING SOFTWARE

Circle 71 on Inquiry Card (RESELLERS: 72)

COMPUTER SYSTEMS

Insight introduces the SUPER DIRECT way to buy!



Better service.

24 Hour Shipping!
Order 24 Hours a Day.
Toll-Free Sales, Service & Support, 7 Days a Week.
Payment Options Galore, including leasing and the Insight Credit Card.
Express Parts Replacement.
FCC Class B Certification. (residential systems).
1 Year Parts and Labor Warranties, 30-Day Worry Free Guarantee.

Faster performance.

24 Bit graphics accelerators are standard in Insight computers. Proven components maximize processing speeds. Continuous testing of component combinations delivers optimal system performance. Federal Express shipping makes sure your purchase gets to you safe and FAST.

Cheaper prices on everything.

The combined buying power of Insight and Hard Drives International keeps your system cost ROCK BOTTOM without compromising quality!

Insight Buy the Super Direct way!

Better, faster, cheaper. Get it all with Insight Computers!

Insight 486 ISA

Fully Upgradable Intel 80486 CPU
4MB RAM - 64K Cache
420MB 12ms IDE Hard Drive w/cache
210MB w/o Stacker™
Non-Interlaced 14" Super VGA Color Monitor
24 Bit 1MB Graphics Accelerator Super VGA Video Card
1.2MB 5.25" Floppy Drive
1.44 MB 3.5" Floppy Drive
2 Serial, 1 Parallel, & 1 Game Port
Enhanced 101 Key Keyboard
MS-DOS 5.0 - Mouse
Full Vertical Case, Desktop Available
Stacker™ and Dr. Solomon's Anti-Virus™ Software

486SX-25MHz

\$1,599

486-33MHz

\$1,899

SUPER BUY!

486DX2-50MHz

\$1,999

486-50MHz

\$2,099

486DX2-66MHz

\$2,299

Insight's 24 hour shipping:

Need a fully-loaded, value-packed '486 right now? No problem! We've specially configured and pre-built our hottest selling systems and they're ready to ship today! Place your order before 5 P.M. (MST) and we'll ship your computer within 24 hours!

*The fine print.

This offer is good as long as these pre-built systems are in stock.

Order by 5 P.M. (MST) Monday thru Friday.

Order is subject to credit approval. P.O.'s subject to additional conditions.

You must order a 486 ISA as listed here (Custom orders take a tad longer).



CD-ROM

Talon **SUPER BUY!**

TA-100

Internal, 380ms access time, 32KB buffer, fast transfer rate. **\$279**

Sony

S-535

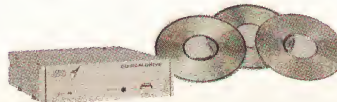
Internal, 340ms access time, 8KB buffer, 150KB/second transfer rate. **\$399**

Talon High Performance TA-200

Internal, 280ms access time, 64KB buffer, 300KB/second transfer rate. **\$599**

Free with any CD-ROM drive -
•1992 Multimedia Encyclopedia
•Stereo Headphones
•Reference Library
•Game Pack.

New for 1992! Toolworks Multimedia Encyclopedia - complete 21 volume set. Over 33,000 articles with 3,000 pictures, 250 maps, 35 minutes of video, 35 minutes of sound recordings and 55 video sequences.



CD Software-Pick any 5 for \$99*

Aircraft Encyclo.	Plant Doctor
Bible Library	Reference Library
Career Opportunities	Sound Works
CIA Factbook	Space-Apollo
Civil War	Timetable of Arts
European Monarchs	Timetable of Science
Game Pack II	USA State Fact Book
Guinness Disc	US Atlas
Great Cities (MM)	US Civics
Interactive Storytime	US Presidents
KGB Factbook	Vietnam
Korea	World Atlas
MM Mavis Beacon	World War II
Teaches Typing	
N. American Indians	

*with purchase of a CD-ROM Drive

HARD DRIVES

HARD DRIVES
International




Super Selection. Super Service. Super Direct! 120MB to 2100MB Hard Drives

120MB  IDE	170MB  IDE	200MB   IDE
Talon TA3020A, 16ms, 3.5" 1"H Bare \$279 8 Bit Kit \$319 16 Bit Kit \$299	Western Digital WD2170A, 12ms 3.5" 1"H Bare \$349 16 Bit Kit \$369	Western Digital WD2200A, 12ms 3.5" 1"H Bare \$399 16 Bit Kit \$419
520MB  IDE/SCSI	535MB IDE/SCSI	660MB SCSI
Fujitsu FJ2624S, 12ms 3.5" HH Bare \$999 16 Bit Kit (IDE) \$1,019 16 Bit Kit (SCSI) \$1,149	Maxtor MX535A/S, 12ms 5.25" HH Bare \$1,159 16 Bit Kit (IDE) \$1,179 16 Bit Kit (SCSI) \$1,309	Micropolis MC1624, 15ms 5.25" HH Bare \$1,399 16 Bit Kit \$1,549
1000MB SCSI	1050MB SCSI	1080MB  SCSI
Seagate ST41200N, 15ms 5.25" FH Bare \$1,699 16 Bit Kit \$1,849	Micropolis MC1598, 14ms 5.25" FH Bare \$1,799 16 Bit Kit \$1,949	Fujitsu FJ2266S, 14.5ms 5.25" FH Bare \$1,499 16 Bit Kit \$1,649
1350MB SCSI	1752MB SCSI	2100MB SCSI
Micropolis MC1528-15, 14ms 5.25" FH Bare \$1,999 16 Bit Kit \$2,149	Fujitsu FJ2652S, 11ms 5.25" FH Bare \$2,849 16 Bit Kit \$2,999	Micropolis MC1924, 11ms 5.25" FH Bare \$3,299 16 Bit Kit \$3,449

Tape Backups

Standard QIC 80 attaches to existing floppy controller or dedicated unit, w/ data compression. 2-3MB/min.

Talon 	
120MB includes one tape	\$189
250MB includes one tape	\$249
Colorado	
120MB	\$199
250MB	\$259

Archive

QIC interface, includes drivers for Novell and DOS.	
250MB Internal	\$799
250MB External	\$899
DAT SCSI - 16 bit, includes drivers for Novell and DOS.	
1300MB Internal	\$1595
1300MB External	\$1795

WangDAT DAT Tape Backups

WangDAT is the premier name in Digital Audio Tape backup systems. These compact units offer the speed and reliability necessary for high capacity tape storage on DOS, Novell and UNIX-based systems.

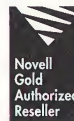
Internal kits - 3.5" with 5.25" frame, controller card, cable, software, mounting hardware.
External kits - external case, controller card, cable, software, SCSI interface and tape included.

2GB 3100 Internal Kit	\$1,199
2GB 3100 External Kit	\$1,299
4GB 3200 Internal Kit	\$1,399
4GB 3200 External Kit	\$1,499



ORACLE®

All versions and upgrades available at the lowest prices.
If you need authorized ORACLE product, call.



Never fear. Insight is here

to satisfy your quest for computer products! Hard Drives International and Insight have joined forces to bring you a superstore in your mailbox. We offer the ultimate selection of today's most popular hardware and software, with the most affordable prices. Get Insight's superior service and support, plus hundreds of products to choose from. It's the Super Direct™ way to have it all - direct to your door faster than a speeding bullet.

Super selection. Super service. Super Direct™.

Super selection.

You'll find every thing you need at Insight. From high-capacity, high-performance storage products to computer systems, peripherals, software and more, Insight is your one-stop source.

Super service.

- 30-Day Worry-Free Guarantee
- Federal Express Delivery
- Toll-Free Technical Support 7 Days a Week
- Payment Options Galore



- 24-Hour Ordering
- One Year Parts & Labor Warranty/Replacement Policy
- Special National Accounts Department for Larger Customers

Super Direct™

Order 24 Hours a Day
Toll-Free 800-998-8040

National Accounts - P.O.s
800-998-8014
APO/FPO/International
602-350-1145
FAX 602-350-1144
Source Code HAU

Insight Distribution Network Inc.
1912 W. Fourth St.
Tempe, AZ 85281
PH 602/350-1128
FAX 602/350-1150

800-998-8040

Insight

**Buy the
Super
Direct™
way!**

Prices and availability subject to change without notice. All items are NEW. POs accepted from qualified buyers- Net 20. APO/FPO orders add \$16 for US Post Express Mail. POs, 30-Day Guarantee and 1-Year Replacement Policy may have some restrictions. Shipping is non-refundable. All trademarks are the properties of their respective owners. Intel Inside is a registered trademark of Intel Corporation. Leasing available for businesses. 11/92

Hassle-Free Printer-Sharing For Your Local Area Network

JetLAN lets you plug your HP LaserJet printers directly into your network...anywhere!



SEE US AT
COMDEX/Fall '92
NOVEMBER 16-20
LAS VEGAS
Booth #S1450

Here's how you can connect your HP LaserJet printers where you want them: near your network users. Without sacrificing centralized file servers for LAN maintenance and network security. Without the expense of dedicating a PC as a print server. And without software that degrades performance and hogs memory on a user's workstation.

Simply slide ASP's *JetLAN*™ print server card into the 'Optional I/O' slot of your HP LaserJet II, IID, III, or IIID. Connect it to the existing twisted-pair or thin-wire cabling anywhere on your Ethernet LAN, the same way you'd add an additional PC. It's that easy! The *JetLAN* installs in less than five minutes. There's no need to shut down the network for installation, and your existing Novell software is all you need.

JetLAN Speeds Up LAN Printing!

The *JetLAN* enhances LAN performance and improves printing speed for graphics and complex documents. And because *JetLAN* plugs directly into your printer and your existing network cabling, there are no individual PC-to-printer cables, external boxes or power supplies to clutter your office. Your system security is enhanced because there's no keyboard or monitor for access to the network.

Maybe your network users are tired of wasting time running across the building to get their laser printer output.

Or you've tried to juggle between security needs and printing convenience when you've located your file servers. And ended up compromising both.

Then take control of your network. Place your printer near the people who need it – with *JetLAN*. From ASP, your “hassle-free workgroup solutions” specialist.

To order your *JetLAN*, or for further information, fax ASP at:

1-800-9 LAN ASP

Dept B2140

International 408-746-2965

ASP
ASP COMPUTER PRODUCTS, INC.



486DX SYSTEMS

quite good, and it's a safe bet that its parts will be available for some time to come.

Considering that the price of most of these machines hovers right around \$2500, it's hard to think of any reasons to buy anything less than a 486. For word processing, maybe. But that justification may not hold for long, because most word processors are moving to Windows. The way the tides are flowing, it's probably better to opt for the most power you reasonably can afford. ■

Howard Eglowstein and Stan Wszola are BYTE Lab testing editors. You can reach them on BIX as “heglowstein” and “stan,” respectively.

COMPANY INFORMATION

Advanced Logic Research, Inc.
9401 Jeronimo
Irvine, CA 92718
(800) 444-4257
(714) 581-6770
fax: (714) 581-9240

Circle 1105 on Inquiry Card.

Atlas Industries, Inc.
11601 Wilshire Blvd.,
Suite 1820
Los Angeles, CA 90025
(800) 285-2711
(310) 478-6920
fax: (310) 479-2334

Circle 1106 on Inquiry Card.

Axik Computer, Inc.
1031 East Duane Ave.,
Suite F
Sunnyvale, CA 94086
(800) 234-2945
(408) 735-1234
fax: (408) 735-1437

Circle 1107 on Inquiry Card.

Bi-Link Computer, Inc.
11606 East Washington Blvd.,
Suite A
Whittier, CA 90606-2425
(800) 888-5369
(310) 692-5345
fax: (310) 695-9623

Circle 1108 on Inquiry Card.

Comex Computer Corp.
3450 South Broadmont,
Suite 110
Tucson, AZ 85713
(602) 792-0100
fax: (602) 792-9722

Circle 1109 on Inquiry Card.

Compaq Computer Corp.
20555 SH 249
Houston, TX 77070
(800) 345-1518
(713) 370-0670

Circle 1110 on Inquiry Card.

TAKE A COUPLE OF GIGABYTES OUT OF YOUR DATA STORAGE PROBLEM



If you're like most PC users, the way your computer devours available storage space resembles... well... a feeding frenzy. You never seem to have enough storage capacity, and when you're mobile, it seems impossible to back up your critical data on the road.

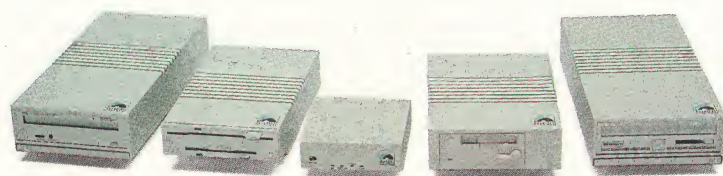
Fortunately, paddling to calmer waters and fail-safe data storage is easy with Parallel Peripherals. All you need is one of our sub-systems and a parallel port (no interface card required). You already have the parallel port, and we have the peripherals—in a format and capacity to satisfy the biggest storage appetite.

Ultra-portable, they simply plug-in to the

parallel port on your portable or desktop computer. And each is equipped with an additional printer port pass-through which maintains full printer capability.

Our portable and lightweight drives are true workhorses, providing the most reliable data storage and the most advanced drive features. And with a one-year factory warranty, you can take a bite out of your storage problem without getting bit.

So if your data storage is going down for the third time, let Parallel Peripherals throw you a line. Portable or desktop, we have the right drive in the right capacity. Call (800)222-7240 for more information.



CD-ROM Drive • Dual Floppy Drive • Battery-Powered Hard Drive • Tape Backup • Removable Hard Drive

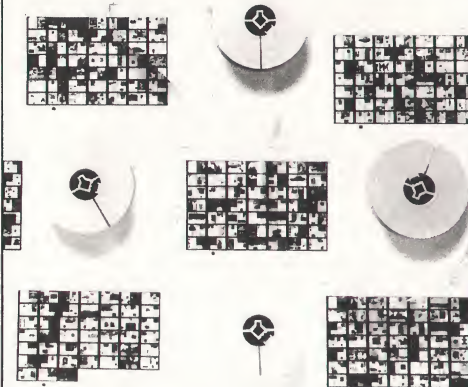


MICRO UNITED





**This publication is
available in microform.**



UMI reproduces this publication in microform: microfiche and 16 or 35mm microfilm. For information about this publication or any of the more than 16,000 periodicals and 7,000 newspapers we offer, complete and mail this coupon to UMI, 300 North Zeeb Road, Ann Arbor, MI 48106 USA. Or call us toll-free for an immediate response: 800-521-0600. From Alaska and Michigan call collect 313-761-4700. From Canada call toll-free 800-343-5299.

Please send me information about the titles I've listed below:

Name _____
Title _____
Company/Institution _____
Address _____
City/State/Zip _____
Phone (_____) _____

U·M·I

A Bell & Howell Company
300 North Zeeb Road, Ann Arbor, MI 48106 USA
800-521-0600 toll-free
313-761-4700 collect from Alaska and Michigan
800-343-5299 toll-free from Canada

COMPANY INFORMATION

CompuAdd Computer Corp.
12303 Technology Blvd.
Austin, TX 78727
(800) 456-3116
(512) 250-1489
fax: (512) 331-6236

Circle 1111 on Inquiry Card.

CompuTrend Systems, Inc.
1306 John Reed Court
City of Industry, CA 91745
(800) 677-6477
(818) 333-5121
fax: (818) 369-6803

Circle 1112 on Inquiry Card.

Daly Computers, Inc.
656 Quince Orchard Rd., Suite 100
Gaithersburg, MD 20878-1409
(800) 955-3259
(301) 670-0381
fax: (301) 963-1516

Circle 1113 on Inquiry Card.

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759
(800) 426-5150
(512) 338-4400
fax: (800) 727-8320

Circle 1114 on Inquiry Card.

DFI-USA
135 Main Ave.
Sacramento, CA 95838-2041
(916) 568-1234
fax: (916) 568-1233

Circle 1115 on Inquiry Card.

Duracom Computer Systems
1425 Greenway Dr., Suite 570
Irving, TX 75038
(800) 551-9000
(214) 518-1200
fax: (214) 518-1090

Circle 1116 on Inquiry Card.

Everex Systems, Inc.
48431 Milmont Dr.
Fremont, CA 94538
(800) 821-0806
(510) 498-1111

Circle 1117 on Inquiry Card.

Gateway 2000, Inc.
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023

Circle 1118 on Inquiry Card.

Insight Distribution Network, Inc.
1912 West Fourth St.
Tempe, AZ 85281
(800) 755-9628
(602) 350-1176
fax: (602) 350-1182

Circle 1119 on Inquiry Card.

Lodestar Computer
18539 East Gale Ave.
City of Industry, CA 91748
(800) 875-7568
(818) 810-3818
fax: (818) 810-5928

Circle 1120 on Inquiry Card.

NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(508) 264-8000
fax: (508) 264-8488

Circle 1121 on Inquiry Card.

Northgate Computer Systems, Inc.
P.O. Box 59080
Minneapolis, MN 55459-0080
(800) 548-1993
(612) 943-8181
fax: (612) 943-6960

Circle 1122 on Inquiry Card.

Packard Bell
9425 Canoga Ave.
Chatsworth, CA 91311
(818) 886-4600

Circle 1123 on Inquiry Card.

Polywell Computers, Inc.
61-C Airport Blvd.
San Francisco, CA 94080
(800) 999-1278
(415) 583-7222
fax: (415) 583-1974

Circle 1124 on Inquiry Card.

QSI Corp.
95 Rockwell Place
Brooklyn, NY 11217
(800) 347-5500
(718) 834-4545
fax: (718) 834-5318

Circle 1125 on Inquiry Card.

Tandy Corp.
1800 One Tandy Center
Fort Worth, TX 76102
(817) 390-3011

Circle 1126 on Inquiry Card.

Tangent Computer, Inc.
197 Airport Blvd.
Burlingame, CA 94010
(800) 466-3300
(415) 342-9388
fax: (415) 342-9380

Circle 1127 on Inquiry Card.

Tri-Star Computer Corp.
120 South Weber Dr.
Chandler, AZ 85226
(800) 755-1000
(602) 961-3401
fax: (602) 961-4010

Circle 1128 on Inquiry Card.

Uniq Tech, Inc.
3640 Westchase Dr.
Houston, TX 77042
(800) 237-4961
(713) 780-7170
fax: (713)-780-7664

Circle 1129 on Inquiry Card.

Wyse Technology, Inc.
3471 North First St.
San Jose, CA 95134
(800) 438-9973
(408) 473-1200
fax: (408) 473-1972

Circle 1130 on Inquiry Card.

STATISTICA/w

Windows,
DOS, Macintosh

STATISTICA/w™ (for Windows) Complete Statistical System with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Complete Windows 3.1 support, DDE, OLE, TT-fonts, multiple toolbars, right mouse button support ■ Unlimited numbers of data-, results-, and graph-windows ■ Inter-window integration: data, results, and graphs can be treated as objects and converted into one another in a number of ways ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lags analysis; quality control; process analysis; experimental design (with Taguchi); and much more ■ Manuals with comprehensive introductions to each procedure and examples ■ Hypertext-based Stats Advisor expert system ■ Extensive data management facilities (spreadsheet with long formulas, block operations, advanced Clipboard support, DDE hot links, relational merge, data verification, powerful programming language) ■ Batch command language and macros also supported, "turn-key system" options ■ All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with toolbars, pop-up windows, and instant 2D, 3D and multiple graphs) ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE or an extensive selection of file import/export facilities ■ Hundreds of types of graphs, including categorized multiple 2D and 3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom design new graphs and add them permanently to menu ■ On-screen graph customization with advanced drawing tools, interactive stretching and resizing of complex objects, interactive embedding of graphs and artwork, special effects, icons, maps, multi-graphics management, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of all 3D and 4D graphs ■ Extensive selection of tools for graphical exploration of data: fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price \$995.

Quick STATISTICA/w™ (for Windows) A comprehensive selection of basic statistics and the full graphics capabilities of STATISTICA/w ■ Price \$495.

STATISTICA/dos™ (for DOS) A STATISTICA/w-compatible data analysis system ■ Price \$795.

Quick STATISTICA/dos™ (for DOS) A subset of STATISTICA/dos statistics and graphics ■ Price \$295.

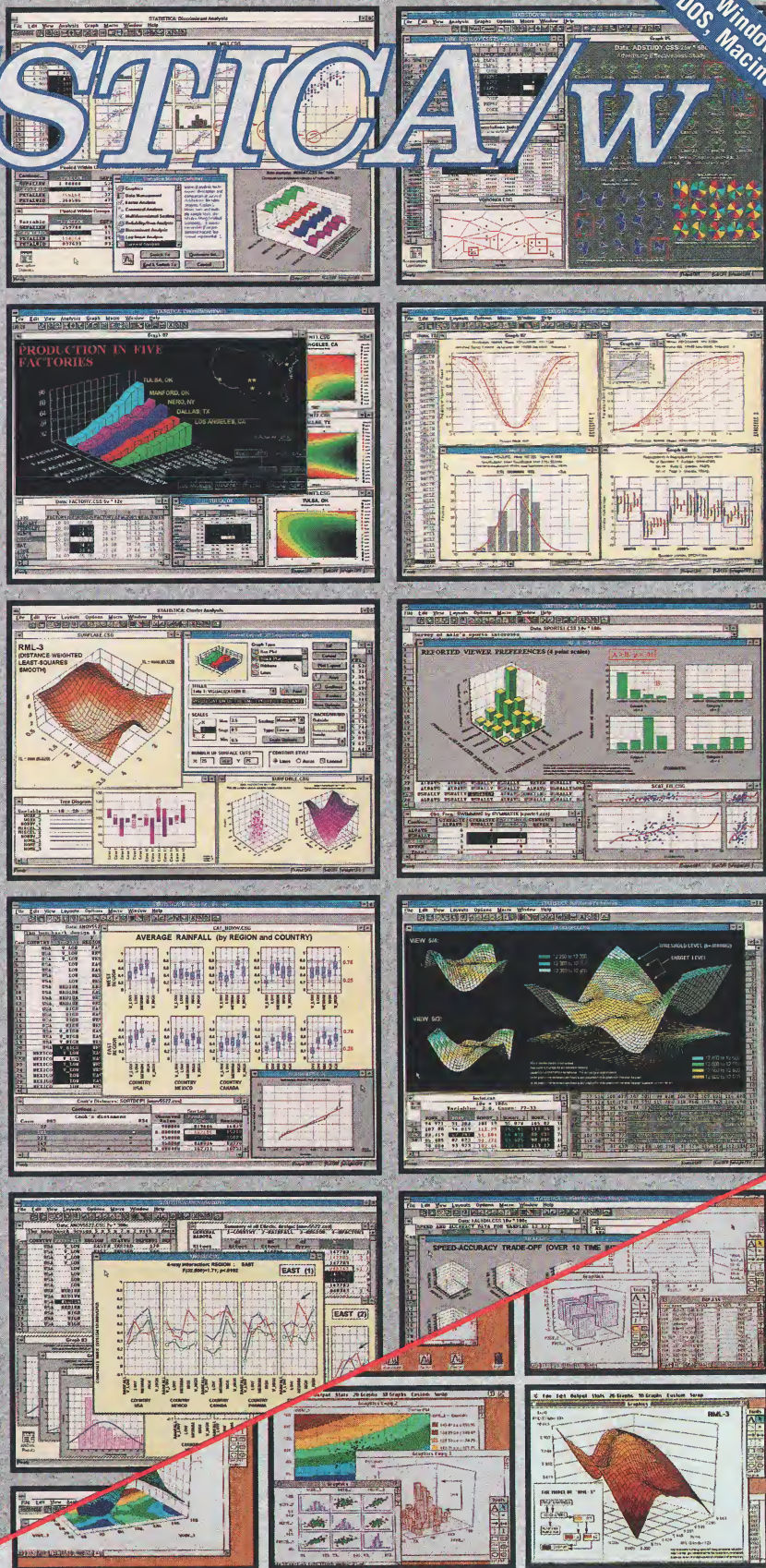
Domestic sh/h \$10 per product; 14-day money back guarantee.

Circle 192 for DOS. Circle 193 for MAC.

 **StatSoft™**

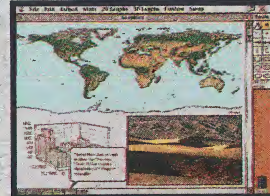
2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149
Fax: (918) 583-4376

Overseas Offices: Statsoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4911310; StatSoft UK (London, UK), ph: 0462/482822, fax: 0462/482855; StatSoft Pacific (Melbourne, Australia), ph: (03) 663 6580, fax: (03) 663 6117; StatSoft Canada-CCO (Ontario), ph: 416-849-0737, fax: 416-849-0918. Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: MAB Juisling, 071-230410; France: Version US (1) 40590913; Sweden: AkademiData 018-240035; Hungary: Dagent Kft 186-5782; Belgium: TEXMA 10 61 16 28; South Africa: Osiris 12 663-4500; Japan (Macintosh): Three's Company, Inc., 03-3770-7600; Japan (DOS and Windows): Design Technologies, Inc., 03-3667-1110.



STATISTICA/Mac™ (for Macintosh) A STATISTICA/w-compatible, comprehensive data analysis and graphics system designed for the Macintosh ■ Large selection of statistical methods fully integrated with presentation-quality graphics (incl. EDA, multiplots, a wide selection of interactively rotatable 3D graphs; MacDraw-style tools) ■ Unlimited size of files ■ Full support for System 7, incl. "Publish and Subscribe" ■ Price \$595.

Quick STATISTICA/Mac™ (for Macintosh) A subset of STATISTICA/Mac: a comprehensive selection of basic statistics and the full graphics capabilities of STATISTICA/Mac ■ Price \$295.



SOFTWARE

Cut to Video: Four Programs for Moving Presentations

TOM YAGER

Business presentations boil down to one thing: You're selling something. Be it a product or a service, an idea, or even yourself, the challenge is to win over others' minds. Make an effective presentation and you could be on your way to your own parking spot. Make a bad presentation and you could be on your way to a career in Fryolator operation.

The most persuasive selling tool multimedia offers is the moving image. For this roundup, I have selected products that share a broad purpose: They integrate video into business presentations. For the Macintosh, I looked at Adobe Premiere and Diva VideoShop. For PCs, I took a look at Mathematica's Tempura Show and AT&T Graphics Software Labs' Panorama. These products use either digital or analog technology to get video into presentations.

There are other programs (e.g., Aim-Tech IconAuthor, HSC Interactive, and Macromedia Authorware Professional) that let you mix moving pictures with other types of media, but they are designed more for developing interactive applications, such as information kiosks and automated product demonstrations, and less for presentations you give in front of an audience. These programs can certainly be used to put together slick business presentations, but that isn't their primary application.

QuickTime and the Digital Route

Apple's QuickTime provides a foundation for the acquisition, storage, and playback of digitized moving video and sound. Both Premiere and VideoShop give you the tools to assemble and edit video and sound into QuickTime movies.

Apple is mounting a campaign to take

QuickTime beyond the Mac and have it adopted as the prevailing desktop digital-video standard. If successful, it will become the first widely accepted method for passing digital video between different types of computers.

Two benefits of the QuickTime video are that it's inexpensive and easy to use: A \$500 board, such as SuperMac's Video-Spigot, and the software that comes with it, are all it takes to turn video into a digital file. QuickTime files, called *movies*, can be played back on other Macs without special equipment.

The QuickTime video, and digital video in general, is not without its cost. Video files are huge, even when compressed, so a few seconds of video can occupy several megabytes of disk space. That's costly, especially once you start thinking about moving that data through networks or modems. The other drawback is that digital video, except in high-end, disk-hogging implementations, delivers material of a lesser quality than the original.

The Analog Alternative

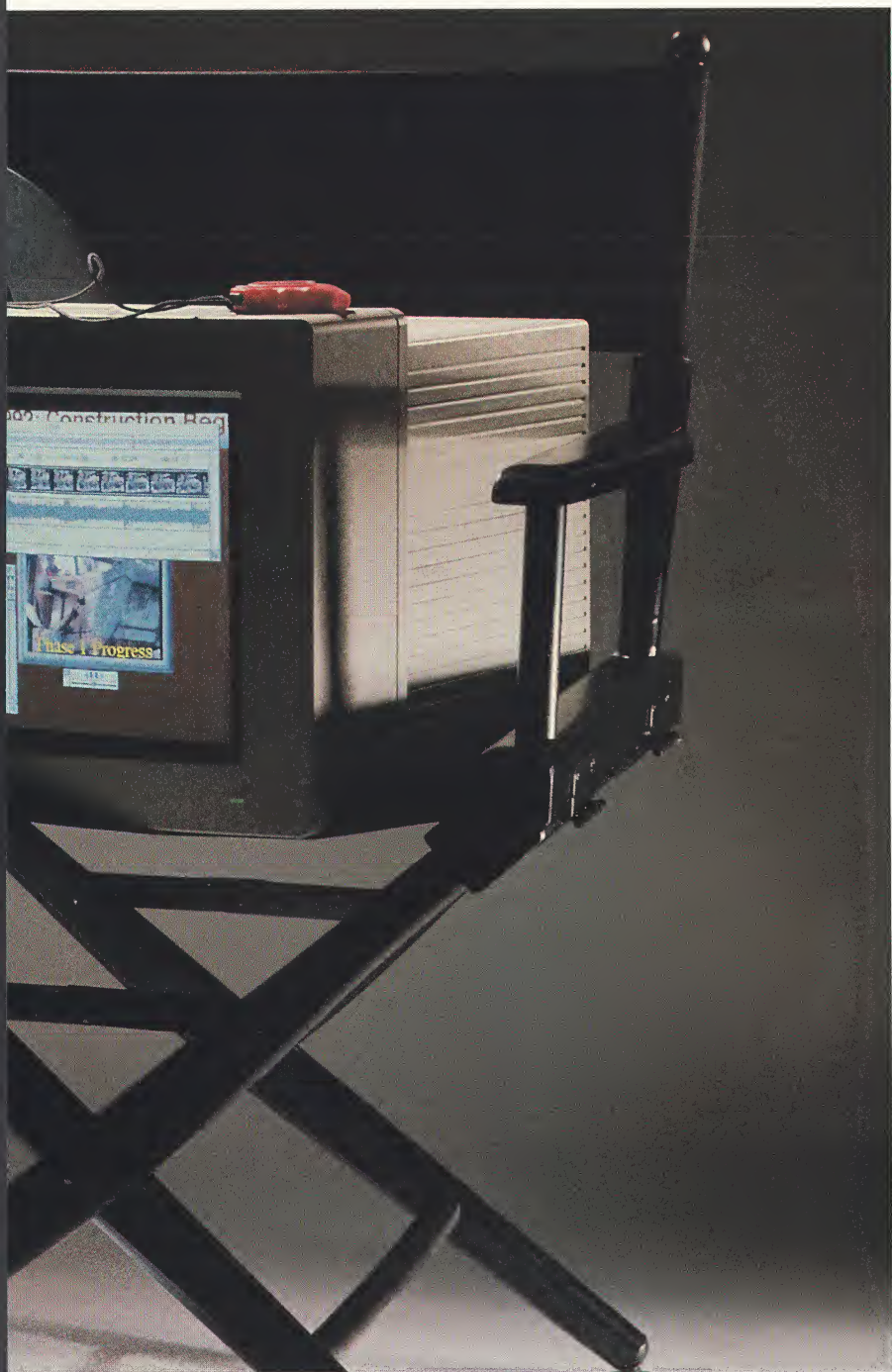
These drawbacks have boosted analog video combined with two other technologies: video overlay boards and computer-controlled video players. These make use of existing analog video equipment to add video to computer-based presentations.

Video overlay, and the similar video-in-a-window boards, typically accept input from external analog video sources (including videotape, laserdisc, and TV) and display it on a computer's monitor. A special class of video overlay boards display their output on ordinary TV sets or video monitors instead. Either way, these boards allow you to combine computer-generated graphics with moving video. Since that video is never digitized to disk, its quality

does not suffer nearly as much, and the higher-quality hardware can actually make video look *better* as it passes through your computer.

A relatively recent development—computer-controlled video recorders—is bringing new capabilities to presenters. Once you hook your computer's serial port into a specially equipped video deck, the same program that sequences your computer graphics for you can position





and play video clips on command. This provides a level of convenience similar to that offered by digital video, but with a far better quality-to-cost ratio.

Computer-controlled video decks are still expensive—in the \$2000 range. The big drawback to analog video is that it has to come from somewhere. You can produce QuickTime movies, combining material from several sources, right on your Macintosh. You can produce analog videos

using your computer, but it costs a lot more and requires additional equipment.

Making Mac Movies

The two QuickTime editing programs I looked at string captured video clips together, letting you add digital audio and computer-generated graphics. Both give you the freedom to carry out complex edits, including transitional special effects that bridge video clips or graphics with

BYTE ACTION SUMMARY

■ **WHAT VIDEO-PRESENTATION SOFTWARE DOES**

These programs enable you to edit and arrange motion video clips for use in business presentations.

■ **LIKES**

Being able to manipulate video and audio sequences, relatively easily, on the desktop.

■ **DISLIKES**

Digital video occupies huge amounts of disk space; the analog approach requires expensive equipment.

■ **RECOMMENDATIONS**

For editing QuickTime movies, Premiere is the premier choice. Under DOS, Temptra Show is inexpensive but capable. Panorama is recommended for PC users who want video output of very high quality.

■ **PRICE**

Premiere, \$495
VideoShop, \$599
Temptra Show, \$199
Panorama: Targa version, \$995;
ATVista version, \$1195

computer-generated animated transitions.

To test the Mac products, I used the BYTE Multimedia Lab's Mac Quadra 700 with 20 MB of memory and a 400-MB hard drive (you need at least 4 MB of RAM in your Mac). It was equipped with a VideoSpigot QuickTime acquisition board from SuperMac Technology. This board has an RCA jack for a single composite video input.

To record audio with your video, you need either an external audio digitizer (like the MacRecorder) or a newer Mac, such as a Quadra, with a built-in audio input. The Quadra 700 has a microphone jack. An attenuating patchcord from Radio Shack allowed me to hook the line-level output from the video decks directly into the Mac. For video input, I used a Panasonic AG-7650 professional Super-VHS player and a Sony CVD-1000 VDeck, a compact Hi-8 VCR. Neither deck was placed under the Mac's control, although both decks support it.

continued

Adobe's Newest Premiere

The latest version of Adobe Premiere, version 2.0, was in beta testing at the time of this review and was slated for an early autumn release. This new software is a major upgrade, showing that Adobe is serious about making Premiere what a colleague of mine called "the Photo-shop for video."

In addition to incorporating its own QuickTime movie-capture facility, version 2.0 has a new titling module. Titles can be animated and can be rendered with transparency and smoothed edges. There's also room for vendors to add

device-control software to Premiere. With that, you can arrange precise, automated capture and "print to video" using computer-controllable video decks.

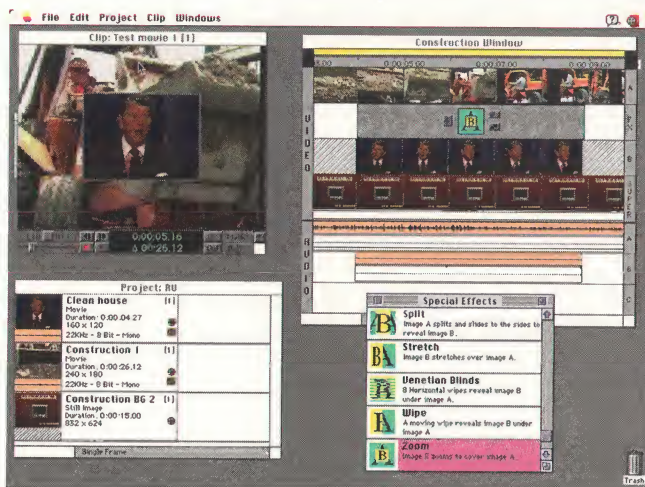
Anticipating the availability of higher-quality video capture and playback hardware, Premiere 2.0 has some features that make it a useful tool for serious video production. If your hardware supports it, Premiere will now handle digital audio at rates as high as 44 kHz, with 16-bit resolution (1.0 is limited to 8-bit resolution). Movies can be turned into, and created from, numbered PICT

files. Those who plan to use Premiere as a component of an existing video-editing suite will appreciate 2.0's support for SMPTE time code and EDLs (edit decision lists). With these, producers can use Premiere to define their edits and then export EDL files to professional editing systems. These files execute the edits using the original tapes and produce broadcast-quality results.

Overall, Premiere 2.0 addresses many needs of QuickTime producers. It has the potential to appeal equally to the dabbler and the pro.

Adobe Premiere

Screen 1: Adobe Premiere uses a "collection and storyboard" approach to acquiring and editing video. You assemble and edit clips in the construction window, shown here in the upper right corner.



Adobe's Premiere was one of the first QuickTime tools to appear (see "Two Tools of the QuickTime Trade," June BYTE), and so it has come to be the embodiment of QuickTime itself for many people. The text box "Adobe's Newest Premiere," above, offers a preview of Premiere 2.0, which at first blush is impressive indeed. But its predecessor certainly deserves top consideration when you're looking for a video-editing program.

Premiere, like most digital (and some analog) video-editing applications, employs a "collection and storyboard" interface (see screen 1). Using a utility external to Premiere (QuickTime acquisition boards come with simple capture programs), you acquire your video clips. The program displays them as little icons in a tidy collection window (in Premiere parlance, a *proj-*

ect window). Digital audio files and still graphics are collected here as well.

You edit movie and audio clips by setting In and Out points. These points determine what portion of a clip will play. If a clip is too long or too short, you can simply adjust the In and Out points.

To create the most basic kind of presentation, you drag movie icons from the project window and lay them end-to-end in the storyboard. Premiere's storyboard is a series of rows, with each row dedicated to a specific type of data. There are three video rows, including one for transitional effects, and three audio rows. The "Super" row in the storyboard is reserved for videos and still graphics that you want to superimpose over playing videos. This lets you add titles, animation, and even video as layers above the rest of your material.

If you lay movie clips end-to-end on the same row in the storyboard, you get an instant transition between scenes, called *cut edits*. If you have a yen for something more visually exciting, Premiere has a library of digital transitional effects. These are cataloged in a floating window, with animated icons that clearly show the effect of each transition. Premiere sports an excellent mix of traditional and eclectic transitional effects, ranging from fairly sedate wipes and dissolves to wilder page turns.

Premiere's video filters have a practical side, adding antialiasing, brightness/contrast control, color balancing, and tinting effects to selected video segments. These filters help you enhance your video by compensating for problems in the original material.

Audio in Premiere is mixed using controls that rest under each audio clip in the storyboard. The level controls are single horizontal lines (one line controls each clip) that represent the audio playback level. The line is initially anchored on both ends by movable points. You can vary the audio playback level over time by moving the points around (they move in all directions). The result is a graph that represents your requested audio mix.

I'm struck by how Adobe has managed to craft a simple interface for such a complex idea. There is very little in Premiere that doesn't feel perfectly natural after its first use. I was initially surprised to find the program accompanied by a very thin manual, but now I get it: A program this well-written requires very few trips back to the documentation.

continued

Maybe they'd get more involved if your presentation had a higher I.Q.*

***Image Quality, that is.**

Introducing Proxima® Ovation.™ The fully portable family of LCD projection panels that provides the most vivid color images available today.

Showcase your computer or video images crisply and clearly, utilizing the latest LCD technology and up to 226,981 true colors.

Ovation offers a dynamic range of multimedia capabilities to move and motivate your audience. Project computer presentations, video recordings, computer animation, TV, even live images from camcorders.

Ovation projects whatever you can see on your PC or Macintosh* monitor. Just place the Ovation panel on an overhead projector, connect the panel to your computer, VCR, camcorder, or other output device, and you're ready to impress your next audience. Make your presentation even more interactive with the Proxima Cyclops™ pointer system. It's like a cordless mouse. Point, click, and pull down menus—right from the projection screen.

There's a Proxima product for nearly every presentation and price range—from monochrome data projection to full-color animation and video. For the name of the dealer nearest you, call **1-800-447-7694 today**. Ask for our booklet which explains the advantages of using today's LCD projection panels.



*Ovation projects to the big screen the same color and clarity that you see on your computer monitor.
Above right: Actual computer monitor image.
Above: Actual projection screen image from Ovation LCD projection panel.*

PROXIMA®

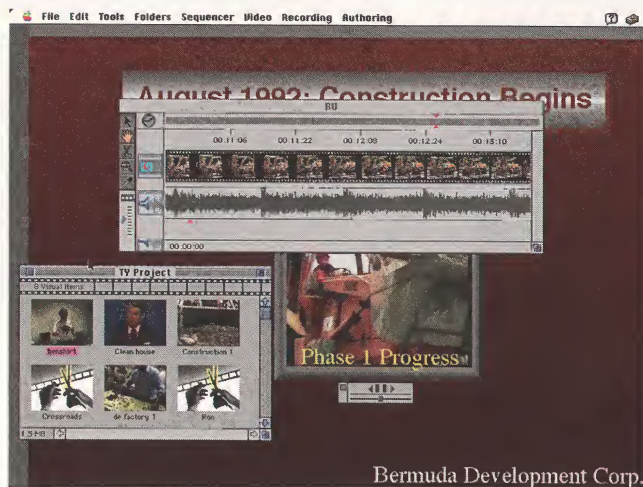
Proxima Corporation 6610 Nancy Ridge Drive
San Diego, CA 92121 (619) 457-5500

In Europe: contact Horsterweg 24, 6191 RX Beek,
The Netherlands, 431-(0) 43 65 02 48. Ovation and Cyclops are trademarks of and
Proxima is a registered trademark of Proxima Corporation.
†Other brand and product names are trademarks of their respective owners.
© 1991, Proxima Corp. All rights reserved.

Circle 231 on Inquiry Card (RESELLERS: 232)

Diva VideoShop

Screen 2: *Diva's VideoShop, like Premiere, uses a storyboard approach, with clips laid out in sequence. VideoShop adheres to a methodology that's more like traditional film editing.*



Bermuda Development Corp.

I was pleased to find that, despite the same basic collect/storyboard interface, Diva's VideoShop program incorporates many unique attributes that make it a worthwhile alternative to Premiere. VideoShop uses HyperCard to create a complete environment, even to the extent of providing Finder-like menu options like Find and New Folder. These are all part of VideoShop's desktop, intended to be a Mac-like environment tuned specifically for video (see screen 2). QuickTime movie files are optionally shown in VideoShop's collections, called folders, as animated icons that play the first several frames of the movie contained there. These "micons" (movie icons) animate only when you select them, so CPU time is not consumed needlessly.

Another VideoShop specialty is its constant preview window. In Premiere, previews are played in a tiny window and can be played only forward, and they are jerky, rough approximations. VideoShop's preview window allows you to play the current storyboard (called a *sequencer*) forward, backward, and at variable speeds, simply by clicking on the preview window's controls.

VideoShop's sequencer window supports an arbitrary number of video and audio tracks; you add more as you need them. To edit a clip, you click on a magnifying-glass icon and then double-click on a clip in the sequencer. This opens a window with an expanded view of the selected clip, giving you a visual that looks and handles remarkably like film. This metaphor is used effectively throughout VideoShop. To trim a clip, you drag over a portion of it with the mouse and press Delete. You can undo edits, but unlike with Premiere, when you make a cut in VideoShop, it stays. It does not, however, affect the original clip; you can always revert back to the original by dragging it in again.

Perhaps the most unique quality of Vid-

eoShop is its support of an arbitrary number of video channels. The multiple video channels can effectively create complex effects like video-in-a-window and title overlay. While Premiere supports the notion of a fixed-size master playback window in which all elements, unless modified by effects, play back at the master window's size, VideoShop uses a resizable playback window in which you can position and size multiple video clips. The clips can play in sequence, simultaneously, or any way you like. Video channels can include still graphics, which VideoShop (oddly) converts into QuickTime movies while importing them.

As with Premiere, VideoShop supports both transitional effects and video filters. But there's a difference in how each program has you apply effects. In Premiere, effects and clips are all distinct, movable pieces, laid out in separate rows in the storyboard. VideoShop applies transitional effects to video clips laid end-to-end on the same line in the sequencer. Transitional effects take place within a channel rather than between channels. This feels a little strange at first, but it's not without its merits. Each video channel can have its own effects, and it's OK for those effects to overlap, which is not the case with Premiere.

VideoShop doesn't offer a very extensive selection of effects. It sticks with basics, like the requisite dissolve (cross-fade) and wipe effects. And VideoShop doesn't provide either Premiere's animated effect icons or Premiere's depth of control over the effects.

Compared with Premiere, VideoShop gives you less power to manipulate effects. You get one chance to preview the effect on your own video, a very nice touch that makes up for the lack of the animated icons, and one chance to press Undo after you commit to the effect. After that,

you're stuck with your changes unless you choose to rebuild the affected portion of your video. That's the one serious drawback of the film metaphor. While VideoShop provides you with constant, high-quality previews, that comes at the price of some changes (like effects) being difficult to undo.

While I found that trade-off acceptable, I could not accept VideoShop's inability to manage audio tracks. Except for a "Set audio level" menu option (which never worked for me), there is no control over the mixing of audio. Video transitional effects don't touch the audio, which abruptly shifts from one clip to the next. I also found disconcerting the program's inability to automatically scale video clips to fit the playback window.

VideoShop does let you record new clips from within the program. I had some trouble with that, however, probably because VideoShop (and Premiere 2.0) requires the use of a special driver, called a video digitizer, that SuperMac still had in beta testing at the time of this writing.

In general, I find Premiere to be the more useful of the two QuickTime tools. I like the film metaphor and the WYSIWYG emphasis in VideoShop, but the lack of audio handling and automatic scaling are enough to keep me running back to Premiere. I have no misgivings about recommending VideoShop for those projects that suit it, such as presentations that need multiple video sequences running simultaneously, but I think Premiere is the better choice for most uses.

Yes, You Can Do This Under DOS

Multimedia development is usually associated with graphical environments, but there are a couple of very capable presentation-making programs that run under plain old MS-DOS. You do not have to be using Windows or hefty Windows applications to build video into your presentation.

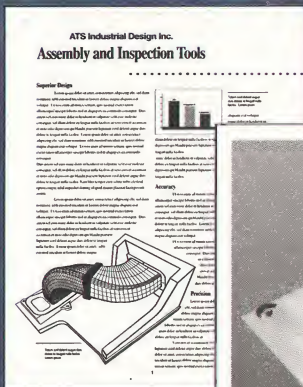
Both of the DOS packages I cover here use analog video input. To evaluate the PC products, I used two systems: an ALR Flyer 32LCT multimedia PC and a Uniq 486/50 server. The ALR was equipped with a Cardinal Technologies SnapPlus combination VGA/video-overlay board, while the Uniq had a Truevision ATVista 24-bit video board. With this hardware, both systems were equipped to handle incoming analog video.

The SnapPlus displays the video in a window on a VGA monitor, and the board also has the benefits of on-board VGA and recordable video output. The ATVista displays incoming video, combined with graphics, on a dedicated TV monitor.

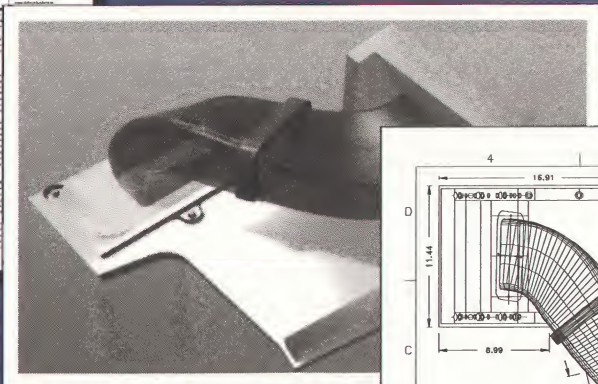
continued

All the benefits of a laser printer on a much larger scale.

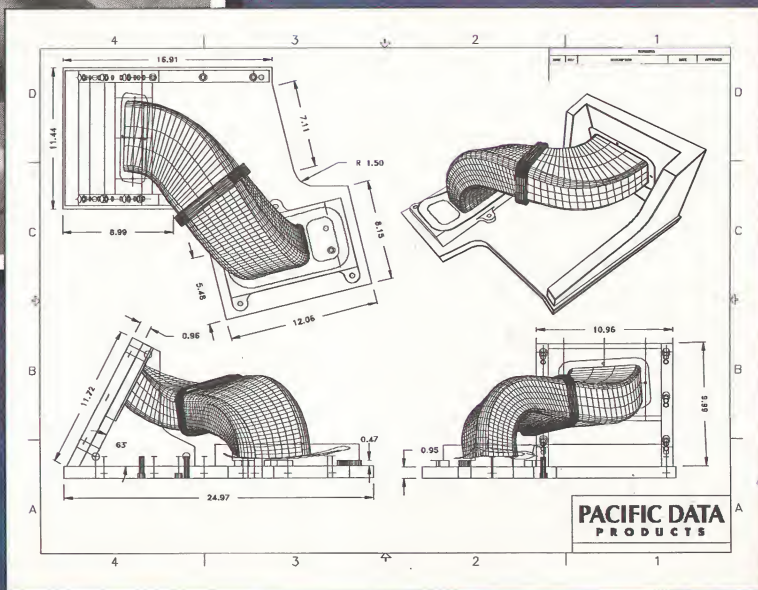
A-size (8.5" x 11")



B-size (11" x 17")



C-size (17" x 22")



At last. A personal output device that combines the best features of a desktop laser printer with the ability to produce large format drawings. It's called ProTracer™—a 360 dpi desktop printer/plotter that produces A, B, as well as C-size output.

FEATURES INCLUDE:

- High performance inkjet engine from Canon®
- Fast, Intel i960™ processor—drawings that take over one half hour on pen plotters take as little as five minutes on ProTracer!
- Optional HP-GL® and PostScript® language emulations, memory expansion boards, and sheet feeders
- Unsurpassed customer service—60 day money back guarantee of satisfaction, one year warranty, and free lifetime technical support

PROTRACER BASE UNIT

- Customized ADI and PADI drivers for AutoCAD users
- Epson and ProPrinter emulations

\$1499

PROTRACER WITH HP-GL

- ProTracer base unit
- HP-GL emulation card
- 5 MB memory

\$2249

PROTRACER FULLY CONFIGURED

- ProTracer base unit
- HP-GL emulation card
- PostScript language emulation card
- 5 MB memory*
- Sheet feeder (100 sheet)

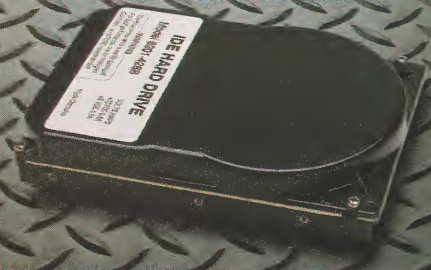
\$2897

If you'd like to expand your printing and plotting capabilities, call Pacific Data Products at (619) 625-3591, Fax (619) 552-0889.

**PACIFIC DATA
PRODUCTS**

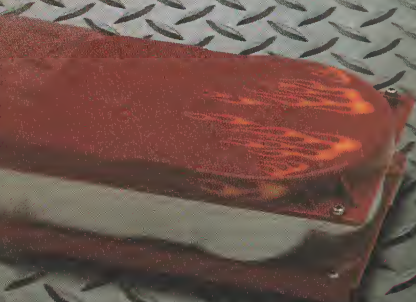
* If outputting C-size PostScript documents, an 8 MB memory board must be used. Pacific Data Products, Inc., 9125 Rehco Road, San Diego, CA 92121. ProTracer is a trademark of Pacific Data Products, Inc. HP-GL is a registered trademark of Hewlett-Packard Co. i960 is a trademark of Intel Corporation. PostScript is a registered trademark of Adobe Systems, Inc. Canon is a registered trademark of Canon, Inc. All other trade names referenced are the trademarks or registered trademarks of the respective manufacturer. ProTracer uses the latest in high technology innovation including PeerlessPage™, the advanced Imaging Operating System from Peerless. PhoenixPage is a registered trademark of Phoenix Technologies Ltd. © 1987, 1988. EUROPEAN OFFICES: England Tel 0800 51 5511, Fax (44) 442 236540; France Tel 05 90 65 09, Fax (33) 1 39 63 20 41; Germany Tel 0130 81 3685; Ireland Tel (353) 61 475609, Fax (353) 61 475608; Switzerland Tel (41) 22 341 26 50, Fax (41) 22 341 06 82; Belgium Tel 078 111292; Netherlands Tel 06 0222065. © 1992 Pacific Data Products, Inc.

THIS IS YOUR DRIVE



THIS IS YOUR DRIVE ON

winSTORE™



ANY QUESTIONS?

SEE US AT
COMDEX
FALL '92
BOOTH
S4670

It doubles your performance.
It doubles your disk capacity.
It's fast and easy to install.
It's priced right.

It's winSTORE™, created for the Windows™ user. The first product of its kind, winSTORE combines two award-winning technologies: high-speed disk control from Perceptive Solutions and advanced Stackster™ data compression from Stac®, in a plug-and-play solution.

It's winSTORE—think of it as overdrive for Windows!

Perceptive Solutions, Inc.
800-486-FAST

Main: 214-954-1774 • FAX: 214-953-1774

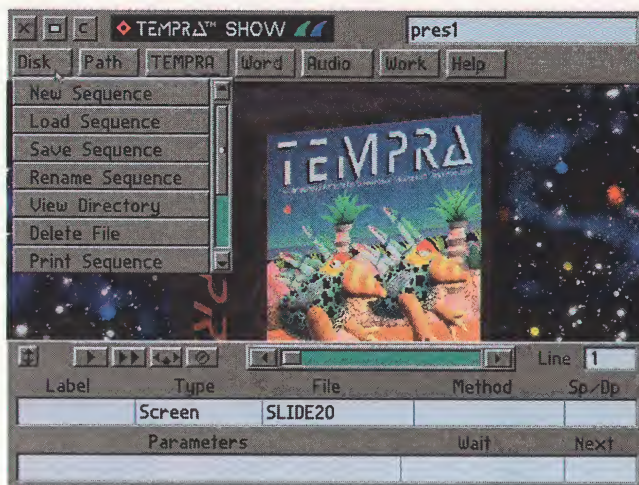
©1992 by Perceptive Solutions, Inc. winSTORE and the Perceptive Solutions logo are trademarks of Perceptive Solutions, Inc. Windows is a trademark of Microsoft® Corp. Stackster is a trademark and Stac is a registered trademark of Stac Electronics, Inc.

Circle 168 on Inquiry Card

CUT TO VIDEO

Tempra Show

Screen 3: *Mathematica's Tempra Show, an easy-to-use presentation package, puts a graphical interface over DOS to walk you through the process of putting events in sequence.*



Mathematica's Tempra Show is a DOS (not a Windows) program that has a GUI wrapper. Presentations created with Show can be played back on any properly equipped DOS machine (a PC with at least a 286 processor, 540 KB of main memory, and 5.5 MB of disk space). This is a very capable but easy-to-use presentation package, and I like its results.

I call Tempra Show a "presentation sequencer." You can't create any new material with it. Its function is to string together various types of multimedia data, generated from other sources, into a self-running presentation. Show can incorporate all sorts of data into presentations: still images (PCX and TGA formats); Autodesk Animator/3D Studio FLI and FLC files; digitized audio, MIDI, and CD audio; text; and, of course, video.

Bringing these data types together in Tempra Show is the script's job. Using the graphical interface, you build the script one event at a time; dialog boxes pop up to prompt you for additional information when needed. The GUI walks you through the parameters associated with each event, such as Screen (to load and manipulate graphics). Once you get used to what some of the cryptic button labels mean (e.g., 80Butn is a Button event in 80-column format), it's not a bad way to navigate (see screen 3).

Building a presentation one line at a time makes it difficult to maintain continuity. You can dismiss the GUI and go down one layer to the text-based interface underneath, but that's a little bewildering. You will, however, be able to see more than one event's worth of the script on the screen, and you can switch back to the GUI very easily.

Tempra Show's handling of the SnapPlus board's video-window capability couldn't be simpler: All you have to do is drag out a rectangle at the size and position

you want the video window to appear, and when that event plays back, the video window pops up. With the SnapPlus, video windows popped up, disappeared, and re-sized rapidly in response to script events, making it easy to maintain a smooth flow. (Show also supports the Creative Labs Video Blaster.)

Tempra Show supports computer-controllable video decks, including the Sony Vdeck, which Show controls through a serial port. The program has a set of VCR events (e.g., play, forward, and rewind) that simulate pressing remote-control buttons. These controls allow for precise seeking and automatic segment playing on time-code-striped tapes. The combination of Show, Vdeck, and the SnapPlus board is one of the most painless and efficient setups I have used for video presentations. While Show's scripts can't rival the programmability of more advanced tools such as Asymetrix's ToolBook and Aimtech's IconAuthor, neither of these can match the ease with which Show compiles even fairly demanding presentations.

The package deserves extra credit for its Build Demo function. Build Demo provides an easy way to let you package your presentation and share it with other people. This part of the program loads a floppy disk or a hard disk directory with a distributable run time of Show, your script, and all the files needed to run the presentation on another machine. It even creates a batch file that launches everything from the command line. This is a simple touch, but it shows that Mathematica realizes that people don't build presentations to show them to themselves.

Tempra Show, even with its couple of quirks, is an excellent solution for many kinds of presentations that incorporate video. Mathematica's program is unique and is an ideal choice for PC users who don't have lots of time or money to invest.

continued

Expand Your View



COMDEX®

Comdex Booth S1882

Yes, it's definitely time you expanded your view to the non-interlaced 15" ViewSonic 6FS monitor.

For one thing, you get 36-percent more viewing space than with a standard 14" monitor. And, since you can display more information on the screen with the larger 15" flat square screen, this is an ideal monitor for Windows, Graphical User Interface (GUI) and desktop publishing environments.

Thanks to the ultra high 72Hz refresh rate with resolution up to 1,024 x 768, the ViewSonic 6FS produces the most vivid and precise **flicker-free** image anywhere. In addition, the non-glare screen reduces irritating reflections.

The monitor, compatible with all standard resolutions, features 32 programmable modes with digital controls to store and customize

the display to fit your specific needs. It also is certified to meet strict MPR-II Swedish certifications for low emissions, which makes it environmentally safe. It's a fact—the ViewSonic 6FS offers special features normally available only on larger, more expensive monitors.

Expand your view, not your budget, with the affordable 15" ViewSonic 6FS monitor.

ViewSonic®

20480 E. Business Parkway
Walnut, CA 91789

(714) 869-7976 (800) 888-8583 Fax: (714) 869-7958

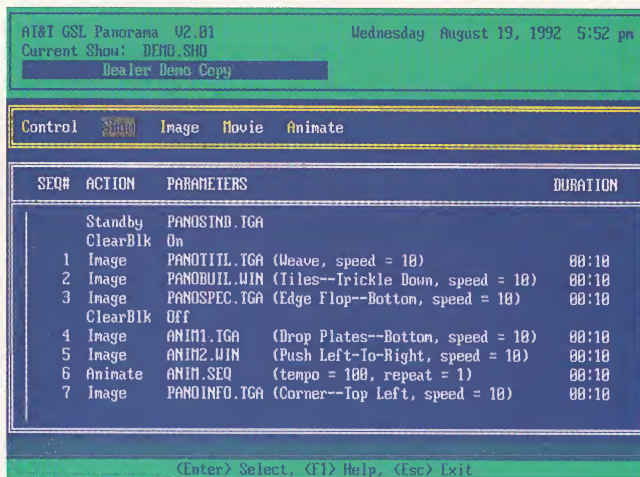
For immediate faxed information, call the FaxSonic "hot line" at (714) 869-7318—it's available 24 hours a day.

All products and brand names are registered trademarks of their respective companies.

Panorama

Screen 4:

AT&T GSL's *Panorama* is a script-oriented sequencing program. Components of a presentation are shown in a list rather than as visual movie icons.



The second DOS program I looked at is a fairly high-end solution: Panorama from AT&T Graphics Software Labs (see screen 4). It's the only one I reviewed that is specifically geared toward creating presentations intended for output to video (or a TV monitor or video projector). It uses the combined video I/O capabilities of Truevision Targa and Vista video boards to bring in video from an external source, combine it with graphics, and send the result back out as recordable video. The quality of the graphics output, thanks to the ATVista's 24-bit color, is superb. What Panorama offers is professional-looking output, suitable for trade show booths, presentations before large crowds, and other situations where image is everything.

Like Show, Panorama is a script-oriented presentation sequencer. The simplest Panorama presentation consists of a string of TGA-format graphics files. Truevision Targa and Vista boards have the ability, rarely tapped, to perform impressive special effects, and Panorama makes use of this power for creating transitions between graphics slides. All the effects are tasteful and suitable for professional applications, but there are some (e.g., squeeze, roll up, and pour) that are custom-made for turning heads.

You build a Panorama script on your PC's main monitor, and the script, along with running status and error messages, is always visible, since the Truevision boards typically use a separate TV monitor for display.

Panorama incorporates video through two Video event types. The Video Live event removes all graphics from the display and shows only video, while the Video Overlay event uses the *live* bit in a graphics file, showing the video through those pixels that have their live bit set. Pixels that are not set live create a graphics overlay.

You can capture and save video still frames from within Panorama for use in your presentations. The program also supports capturing motion video. You can capture as many frames as will fit in your video board's memory at once. For example, with a 4-MB ATVista, I could capture 64 frames. At full speed, this movie would play back in 2 seconds, but by specifying frame delays you can lengthen the movie's time by reducing the frame rate. Panorama movies aren't meant to be substitutes for video, and at the 64-frame resolution the images look pretty horrid close up. Still, for material that doesn't call for great detail, the movie feature comes in handy.

You can also add motion to a Panorama show through animation. It supports simple path-based animation of any graphics, but it is tuned for *clips*, images that are some fraction of the display size. A simple interface lets you set key points along the animation path and adjust the spline tension of the lines running between the key points. When you play the script, the animation event moves the clip along the path you specified.

Targa and Targa+ owners benefit from additional features in version 3.0 of Panorama, which is not available for the ATVista board. Version 3.0 adds the ability to play back digital audio files (through Sound Blaster and Pro Audio Spectrum boards), as well as interactivity for kiosk-style applications, more transitional effects, and the ability to animate multiple graphics clips at once.

I'm put off by GSL's failure to release Panorama 3.0 for the ATVista, but the Targa boards are more popular. The quality of Panorama's output sets it a bit above the rest of the pack, and the enhancements in version 3.0 widen that gap even more. For presentations that require video output, Panorama is an excellent choice.

A More Elegant Solution

The tools described here are good representatives of the kinds of practical applications that exist today. They are all good, solid packages. For editing QuickTime movies, Premiere is a cut above VideoShop because it gives you better control of effects and has slick audio-handling facilities. Tempra Show is inexpensive and easy to use; it's an ideal solution for people who don't have lots of time or money to invest. Panorama stands out for the superb quality of its output.

Using video in presentations used to mean setting up a VCR next to an overhead projector. Computers offer tight integration of video with other data, making for presentations that flow smoothly and leave a strong impression. Only video can transport audiences to another place. ■

Tom Yager is a BYTE technical editor and director of the Multimedia Lab. He's working on his second book, The Multimedia Producer's Handbook (Academic Press, forthcoming). You can reach him on BIX as "tyager" or on the Internet at tyager@byteb.byte.com.

COMPANY INFORMATION

Adobe Systems, Inc.

(Premiere)
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(415) 961-4400
fax: (415) 961-3769

Circle 1231 on Inquiry Card.

AT&T Graphics Software Labs

(Panorama)
8888 Keystone Crossing, Suite 1490
Indianapolis, IN 46240
(317) 844-4364
fax: (317) 575-0649

Circle 1232 on Inquiry Card.

Diva

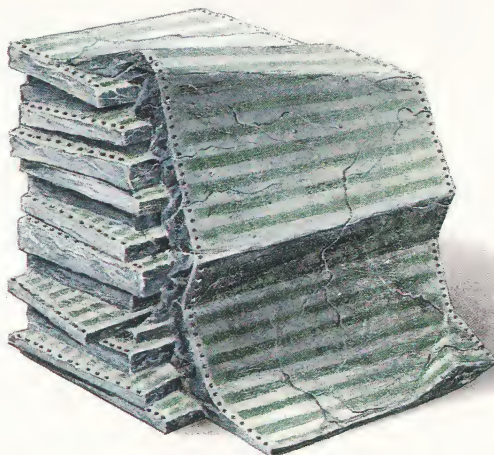
(VideoShop)
222 Third St., Suite 3332
Cambridge, MA 02142
(617) 491-4147
fax: (617) 491-2208

Circle 1233 on Inquiry Card.

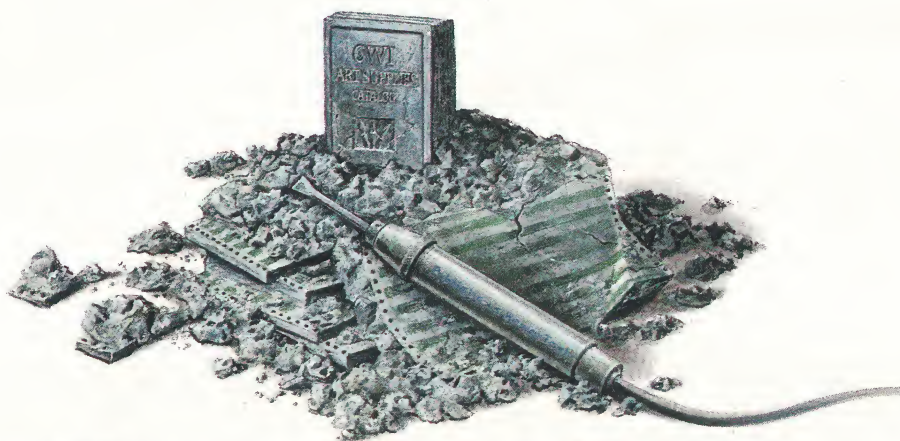
Mathematica, Inc.

(Tempra Show)
402 South Kentucky Ave.
Lakeland, FL 33801
(813) 682-1128
fax: (813) 686-5969

Circle 1234 on Inquiry Card.



**ENOUGH DATA TO SINK THE QUEEN MARY,
BUT ALL YOU WANT IS A MONTHLY CATALOG.**



**GET IT OUT OF YOUR SYSTEM. FAST.
VENTURA DATABASE PUBLISHER 4.0.**



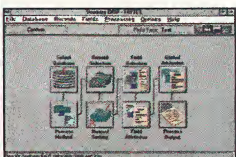
O.K., so you've got all this information sitting in your database. But what happens when you need to carve out a monthly catalog, phone directory, sales report, or any other data-intensive publication?

You can use your report writer to crank out a ton of greenbar. Or beg programming for help. Or write your own code. Or re-key the data, set type, and hope for the best. Right?

Wrong. Because now there's a way to transform your data into a professional-looking report quickly. Automatically. With push-button simplicity.

Ventura DataBase Publisher® 4.0 for Windows.

Capture only the data you want. Any way you want. Any time you want. From dBASE, FoxPro, Excel, Lotus 1-2-3 for Windows, or just about any other database.



Then automatically convert it, format it, and publish it on demand—through Ventura Publisher®, Word for Windows, WordPerfect, PageMaker, or Ami Pro. Ventura DataBase Publisher can turn your DTP or WP program into the ultimate report writing power tool.



Take the weight out of database publishing. Put automation in.

Check out Ventura DataBase Publisher at your dealer.

Or call **(800) 822-8221**.



Ventura DataBase Publisher 4.0 for Windows.

The PowerTool for Publishing Your Database on Demand.

**Ventura
Software Inc.**
A Xerox Company

15175 Innovation Drive, San Diego, CA 92128 • (800) 822-8221

©1992 by Ventura Software Inc. All rights reserved.



AS SEEN IN LAN COMPUTING

Put more power in your PC

Plug MKS Toolkit into any DOS or OS/2 PC and you'll unleash more power and flexibility than you ever believed your hardware could handle. You'll find that MKS Toolkit is the essential piece of DOS or OS/2 software after the operating system itself.

Advanced programming tools once available only on UNIX™ systems are packed into MKS Toolkit for DOS or OS/2 – more than 150 of them, including utilities for:

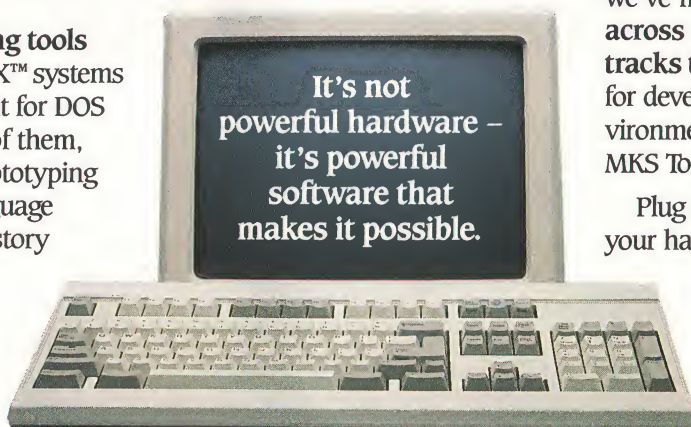
- prototyping
- advanced command language
- command editing and history

- file processing • text manipulation
- compression • archiving • editing.

And MKS Toolkit is **easy to use**, with on-line manual pages, lots of examples and quality documentation for both novices and experienced users.

You'll be able to get the job done effortlessly too, wherever you're working. For laptop owners, our installation procedure lets you **load only the utilities you want**. For developers working on a UNIX system and a PC, we've made it **easy to copy files across systems**. And MKS Toolkit tracks the **POSIX.2 standard**, a plus for developers in open systems environments. **Networks** are perfect for MKS Toolkit too.

Plug in MKS Toolkit and soar beyond your hardware.



MKS Toolkit

Australia 03 580 1333
03 419 0300
Benelux 020 6 14 24 63
Brazil 083 322 1904
Denmark 04288 7249
England 0736 244114
0386 53499
071 833 1022

Finland 8 0 505 4536
France 01 4877 2244
01 4781 1011
Germany 0551 507 620
0721 988 280
06 126 595 0
030 852 00 45
Italy 02 480 1111

Singapore 65 747 2266
Sweden 0131 115 88
0314 060 25
Switzerland 061 47 32 01
032 255 743

Full 30 day
money back
guarantee.

MKS 35 King Street North
Waterloo, Ontario
Canada. N2J 2W9

MKS and MKS Toolkit are trademarks of Mörice Kern Systems Inc.
UNIX is a registered trademark of Unix System Laboratories, Inc.

HARDWARE

Compaq Unveils a New Network Printer

GREG LOVERIA

The importance of any printer's standard features—paper handling, performance, reliability—is magnified when you place the printer on a large network. Even a feature such as emulation sensing, which seems like a luxury on a stand-alone printer, becomes a necessity on a printer handling numerous jobs from multiple platforms. Any new network printer must measure up to some very demanding expectations.

New to the printer market, Compaq Computer has designed a couple of network printers poised to meet those high expectations. The most striking feature of the new Pagemarq line of network printers is affordability.

A Network of Printers

The Pagemarq network laser printers offer a long list of standard features and options that should appeal to discerning LAN administrators. Based on a Fuji/Xerox print engine, Compaq's Pagemarq 15 (\$3999) and Pagemarq 20 (\$5499) offer output speeds of 15 and 20 pages per minute, respectively. Options on the Pagemarq 20 that I tested included 8 MB of RAM, NICs (network interface cards; AppleTalk for \$269, Token Ring for \$799, and Ethernet for \$599) for connecting directly to a LAN, a 9600-bps Group 3 internal fax (\$659), a 1-MB font module (\$259), and a 60-MB internal hard drive (\$659). These are list prices, and they'll probably be discounted through dealers.

An on-board AMD 29000 RISC processor, operating at 20 MHz on the 20-ppm unit and 16 MHz on the 15-ppm model, along with Compaq proprietary ASICs (application-specific ICs) and transmission data compression, work in conjunction to speed printing. Both units ship with 4 MB of RAM. The Pagemarq 20 can be expanded to 20 MB, and the Pagemarq 15 can go to 18 MB with convenient SIMM upgrades. One parallel and one serial port are included; both printers can receive and process print data simultaneously from either port. The Pagemarq supports the latest versions of the two industry-standard PDLs (page-description languages), version 5 of Hewlett-Packard's PCL (Printer Control Language) and Adobe PostScript Level 2.

I used to share a standard HP LaserJet Series III printer networked with other

Compaq's speedy Pagemarq 20 offers enhanced resolutions of up to 800- by 400-dpi, automatic port switching, and emulation sensing.



writers and illustrators. We had to generate lengthy aerospace technical manuals, and problems often arose when switching between PCL and PostScript. Since the LaserJet III was a PCL printer, we would install a PostScript emulation cartridge to print from Windows applications; however, for CAD plots, most of us printed without the cartridge using PCL. Checking the printer cartridge's installation status was mandatory before each print job. Anyone who has ever inadvertently printed a single page of PostScript data to a printer in PCL mode knows of the reams of paper—and time—wasted when a printer is improperly configured.

Emulation sensing solves this problem. The Pagemarq automatically determines the language required to service a print job and routes the job to the proper interpreter. No user intervention is required. I tested the automatic-sensing feature between PCL and PostScript emulations from both DOS and Windows applications. In both environments, I first used an HP Series II driver, and then I switched to a PostScript device driver (an Apple LaserWriter IINTX). The feature worked flawlessly, and print speeds between the two modes were almost identical.

In addition, multiple computers and networks can access the printer at the same time, thanks to the port-switching feature

that can simultaneously service jobs from all active ports (i.e., serial, parallel, fax, AppleTalk, and the NICs). In a diverse computing environment, emulation sensing and port switching are mandatory features.

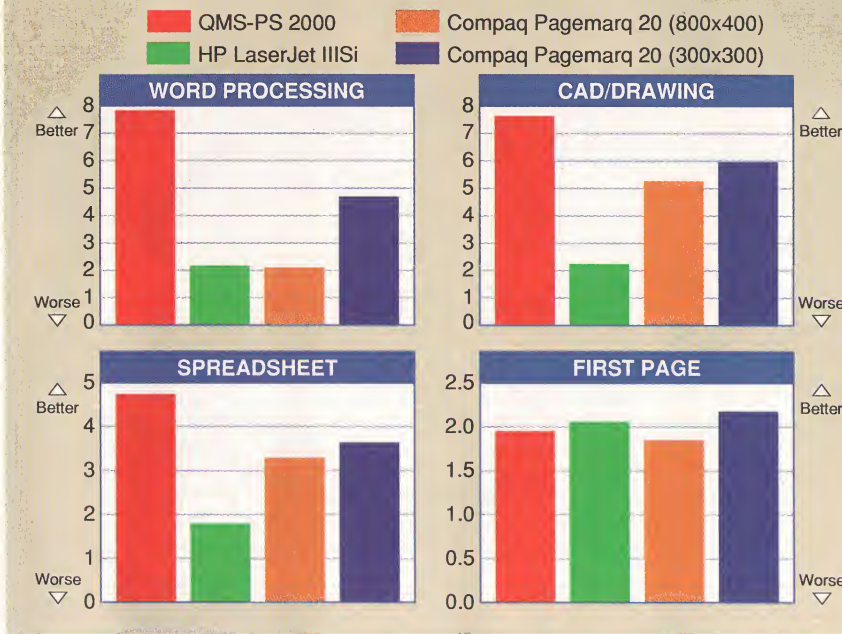
Paper Handling

The Pagemarq 20 arrived with three front-mounted, 500-sheet, 8½- by 11-inch motorized paper trays as standard features. Unfortunately, you cannot tell visually whether the paper is low. Even though the printer beeps loudly when all trays are emptied, most administrators would prefer a better way to keep track of the paper load. Single sheets and envelopes can be fed manually into the printer, but only via a rear-access flip-down panel. If you work with a lot of envelopes, you'll want the optional multipurpose feeder.

For print runs longer than 500 pages, you can configure the trays for auto-selection; when one tray empties, the next one loads. The only hitch here is that you will still have to empty the paper-output receptacle after 500 sheets have come through.

You can select individual trays from the front panel or on-screen using a remote printer control utility (more on this later), allowing different paper weights or colors to be selected from separate trays without reloading. I tested a variety of papers in

BYTE BENCHMARK RESULTS



The Pagemarq 20 compared favorably to the HP LaserJet IIISi in the BYTE PostScript tests.

the 16- to 28-pound weight range and the output was identically crisp, with deep un-streaked blacks, on all paper stocks in my arsenal.

For CAD/CAE applications, both Pagemarq units can also print to 11- by 17-inch paper, using the optional B-size tray (\$99). In my print tests from AutoCAD release 12, in both PCL and PostScript modes at 800 by 400 dots per inch, 11- by 17-inch plots were outstanding and, at this resolu-

tion, rivaled some of the best electrostatic and plotter output I've seen.

Getting Directions

A small 2-row by 15-column LCD and a slick little eight-button control panel provide convenient access to the printer's set-up attributes and menus. The Pagemarq uses "on-line" documentation: Four extensive printer-setup menus are built into the unit's control ROM. Each menu is

loaded with submenus and branches that take you to a specific printer-setup function, such as emulation sensing (on or off), lines per page, and page orientation.

You can access all menus easily via the front control panel, but it helps to know where you're heading. At any main or branch menu display on the LCD, you can get a hard-copy "road map" for that particular menu, complete with every sub-branch and current printer setting.

In a network environment, some users will output only text documents while others will print documents with embedded line art and halftone graphics. The Pagemarq has multiple dpi resolutions (up to 800 by 400 dpi) that can satisfy all these needs. At 300 dpi, both text and graphics using PostScript Level 2 look great, but 800- by 400-dpi printing is where the Pagemarq really shines. Halftoned images output using Aldus PhotoStyler and Page-Maker 4.0 look almost as good as results from a high-resolution typesetter.

The Administrator utility is a point-and-shoot GUI invoked from DOS (it can also be called as a full-screen application within Windows). With it, any authorized user can access most printer-setup and configuration parameters directly from a network node.

Typefaces and Other Fax

Both Pagemarq printers ship with 15 PCL fonts and the 35 standard Adobe Type 1 typefaces. Using the Administrator utility, you can download additional Type 1 or PCL typefaces directly to printer RAM or, for permanent storage, into the optional 1- or 2-MB (\$259 and \$399) programmable font module, a nonvolatile EEPROM. Once downloaded to the printer module, the typefaces are automatically available from your application. You no longer need to worry about downloading fonts. Typefaces can also be downloaded and stored on the optional \$659 60-MB internal hard drive.

Downloading typefaces through a parallel connection is relatively slow, but once accomplished, you can delete typefaces from your system's hard disk, freeing up valuable space. It took 6½ minutes to download 27 Type 1 faces (2.2 MB) from my Zeos 486/25 system to the printer's hard drive. Times were identical for downloading to the module. The optional hard drive is expensive, but it can also be used as a print and fax document-caching device to enhance performance. Using Compaq's Administrator utility, or from the printer's LCD control panel, you can remotely output printed reports detailing all faces stored in printer RAM, ROM, or on the printer's hard drive.

continued

BYTE ACTION SUMMARY

WHAT THE PAGEMARQ 20 IS

A 20-page-per-minute laser printer designed for large networks.

LIKES

Reasonably fast performance, good print quality, and a relatively low price.

DISLIKES

No way to monitor a low-paper condition. Printouts on 11- by 17-inch paper require an optional tray.

RECOMMENDATIONS

The Pagemarq 20 is an exceptional network printer. It's a recommended solution for most network printing needs.

PRICE

\$5499

FOR MORE INFORMATION

Compaq Computer Corp.
P.O. Box 692000
Houston, TX 77269
(713) 370-0670
fax: (713) 374-4583
Circle 1228 on Inquiry Card.



CHOOSING THE WRONG BACKUP SYSTEM WILL KEEP YOU UP AT NIGHT.

Because promises of higher capacities, faster transfer rates, and better media may not fly. But our digital helical scan data storage products are already universally accepted and reliability tested in the most demanding environments on more than 100 platforms worldwide. And we've shipped over 450,000 units to prove it.

Each EXABYTE product builds one upon another, providing capacities and transfer rates that complement preceding products. Backward compatibility enables users to take advantage of technology advances yet protects their archival data investment. Standard, readily available data grade tape makes high-capacity storage easy and affordable.

For more information on the worry-free family of helical scan storage products, call us today at 1-800-EXABYTE.

It's OK to do business with companies selling backup systems lacking formal standards, compatibility, and OEM acceptance. But when it comes time to back up their promises with real support, will they give a hoot?

*The EXB-8500 Full-High
8mm Cartridge Tape Subsystem
and the EXB-8505 Half-High
8mm Cartridge Tape Subsystem
meet your high-capacity
data storage requirements.*



Eastern U.S. (407) 352-5622, Ext. 82
Central U.S. and Canada (708) 953-8665
Western U.S. (408) 370-6107
Europe (Amsterdam) 31-3403-51347
Asia (Singapore) 65-3308381

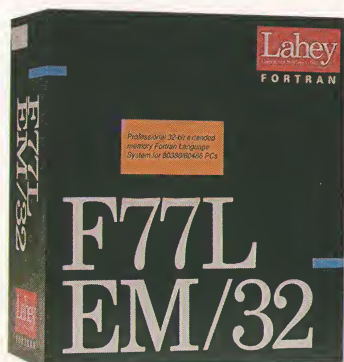
EXABYTE Corporation 1685 38th Street Boulder, CO 80301

©1992 EXABYTE Corporation. EXABYTE is a registered trademark of EXABYTE Corporation.

SEE IT AT COMDEX! BOOTH 4444.

EXABYTE®
THE CAPACITY TO SUCCEED

Just Add Code.



32-bit protected-mode Fortran

Your Fortran code is important. Trust it to the company that has been writing award-winning Fortran language systems for 25 years.

(800) 548-4778



Fortran is our forte

(702) 831-2500 ■ Fax: (702) 831-8123 ■ P.O. Box 6091 ■ Incline Village NV 89450

NEW
Version 5.0
Includes Phar-Lap
386DOS-Extender

COMPAQ NETWORK PRINTER

The internal 9600-bps send/receive fax modem (\$659) is CCIT Group 3-compatible and allows any networked user to generate and send fax documents from within Windows or DOS applications using pop-up utility menus. When you print a document from within any DOS or Windows word processor, a pop-up window asks whether you want to print or fax the document. If you choose fax, a cover page is generated and the document is sent down the network to the Pagemarq for fax transmission. You can even send PostScript files directly to another Pagemarq. It's an elegant fax implementation.

To the Test

In straight parallel tests of the Pagemarq 20 unit, print speeds were compared with those of network printers previously tested by the BYTE Lab (see the figure). The tests are a customized subset of the industry-standard Genoa Technology test suite. The First Page test indicates how fast a printer can pump out short memos or business letters. The Spreadsheet test prints pages from different versions of Lotus 1-2-3 and Microsoft Excel, including heavily formatted text and 3-D graphs. The CAD/Drawing test uses samples from AutoCAD, several illustration packages, and desktop publishing software. The Word Processing test generates formatted documents with numerous font changes.

Although the Pagemarq posted median-to-swift print speeds in these tests, note that the unit was compared against a network printer almost three times more expensive (the QMS-PS 2000) and in a parallel environment. In the end, your network print times will be increased or decreased by network server speeds and interface cards. Data transmission times using NICs, dependent on the network and how it is tuned, can be much faster than a straight parallel connection, with rates up to 16 MIPS. For a description of the LaserJet IIISi and the QMS-PS 2000, as well as descriptions and test results of some other major network printers, refer to the network printer roundup "Laser Muscle: Five Printers Built to Handle Networks" in the February BYTE.

Compaq's Pagemarq printers should be viewed as total network print solutions rather than just laser printers. The Pagemarq 20 can do everything the LaserJet IIISi can do—for less money. It's a good value and a recommended solution for your network printing needs. ■

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and writer in Binghamton, New York. He can be reached on BIX as "loveria."

SUNDAY 10-5

COMPUTERS

ALR Flyer 386SX 25 MHZ
1 MB 1.44 F/D 60 MB 799.00
486 DX 2/50 MHZ 4 MB
1.44 F/D 80 MB VGA 1999.00

COMPAQ

Prolinea NEW 486 DX33
84 MB HD 4 MB Ram 1624.99

NEC POWERMATE

486 DX331 4 MB 240 HD
DOS 5.0 MSWin 2199.99

SCANNERS

HP ScanJet Plus 599.99
HP ScanJet IIP 849.99
HP ScanJet IIC Color 1299.99
Microtek MSF600G CALL
Microtek MSF600Z Color 1199.99

NOTEBOOK COMPUTERS

AST PREMIUM EXEC 386 SX
20 MHZ 60 HD 2 MB 1269.99
20 MHZ 80 HD 4 MB 1499.99
25 MHZ 120 HD 4 MB CALL

TEXAS INSTRUMENT TM 4000

25 MHZ 486 SX 20 HD 1549.99
25 MHZ 486 DX 120 HD CALL

TOSHIBA

T-1800 386 SX 20 HD 1549.99
T-2200 SX 80 HD 2594.99
T-3300 SX 80 HD LGO CALL
T-4400 SX 80 HD Gas Plasma 3249.99
T-4400 SX 120 HD Color 4749.99
T-6400 SX 120 HD Color CALL
T-6400 DX 200 HD 4849.99

HEWLETT PACKARD PRINTERS

Canon BJ-10EX 299.99
Canon BJ-20 369.99
Epson LQ-570 259.99
Epson LQ-1070 569.99
Epson LQ-1170 169.99
Epson LQ-810 204.99
Epson Action 3250 289.99
Oki 320 419.99
Oki 321 209.00
Oki 380 CALL
Oki 590 879.99
Oki 595 144.99
Oki 393 Plus 189.99
Panas. KXP 1180i 259.99
Panas. KXP 1123 334.93
Panas. KXP 1124i 159.99
Panas. KXP 1624 234.99
Panas. KXP 2180 234.99
Panas. KXP 2184 CALL
Panas. KXP 2624 CALL

HARD DRIVES

40 MB IDE 164.99
80 MB IDE 224.99
120 MB IDE 298.99
200 MB IDE 399.99

FACSIMILE (FAX)

Brother Fax 600 349.99
Canon Fax 40 419.99
Canon Fax 50 899.00
HP Fax 200 CALL
HP Fax 310 489.00
Panalax UF128M 899.00
Panalax UF311 379.99
Pana. KXF-50 479.99
Pana. KXF-90 479.99

NEC LASER PRINTERS

HP Desk Jet 500 599.99
HP Laser IIP Plus 739.99
HP Laser IIP 939.99
HP Laser III CALL
HP Laser IV New In Stock
HP Laser I/II 3349.00
HP Laser I/III 594.99
Panasonic KXP 4410 829.00
Panasonic KXP 4430 CALL
Panasonic KXP 4450i 579.99
Panasonic 400 899.99
Oki Laser 400 999.99
Oki Laser 810 1369.99
Oki Laser 95 94.99
NEC Model 95 99.99
2 MB FHP Laser Jet 99.99
2 MB Mem. I/Okidata 119.99
2 MB Mem. I/Panasonic 89.99
UDP 25 In One F/LJ 399.99
Pacific Page w/2 MB 639.99
Pacific Page XL 639.99

HEWLETT PACKARD ORGANIZERS

HP 95LX 512K 369.99
HP 95LX 1 MB 549.99
HP 95LX 4 MB 49.99
Casio SF 4300 32K 66.99
Casio SF 5300 64K 94.99
Casio SF 8000 64K 94.99
Casio SF 9500 64K CALL
Casio SF 9700 64K CALL
Sharp ZQ 5200 64K 195.00
Sharp IQ 8200 128K 289.99
Sharp IQ 8400 256K 289.99

PROMPT DELIVERY

EVEREX

MITSUBISHI ELECTRONICS

SON

Microsoft

SHISHA

NOVELL

TECH

IN USA & CANADA & P.R. INCLUDING NY STATE

1-800-874-1235

S & W COMPUTERS & ELECTRONICS

Fax: (212) 463-8335 (Include Voice & Fax #)
31 West 21 Street, New York, NY 10010
NYC (212) 463-8330

Non-Thurs. 9-6 Fri. 9-1:45
Saturday Closed

• DISCOVER • M.C. VISA. COD w/Deposit • No surcharge for credit cards. Ship. add'l Handling 2% Qty. Ltd. Prices subject to change. Returns w/written authorization Free Parking Sunday. Meter Parking available. Prices for consumers.

PRICES HARD TO MEET — SERVICE HARD TO BEAT! World Wide Inquiries Promptly Filled

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want FREE information on the following products!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

Fill out this coupon carefully. Please Print.

Name _____

Title _____

Company _____

Address _____

City _____ Country _____ Code _____

Phone _____ Fax _____

A. What is your primary job function/principal area of responsibility? (Check one)

- 1 ☐ MIS/DIP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

- 7 ☐ Senior-level 9 ☐ Professional
8 ☐ Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- 10 ☐ Yes 11 ☐ No

D. What operating systems are you currently using? (Check all that apply)

- 12 ☐ PC/MS-DOS 15 ☐ Unix
13 ☐ DOS+ Windows 16 ☐ MacOS
14 ☐ OS2 17 ☐ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- 18 ☐ 1-25 20 ☐ 51-99
19 ☐ 26-50 21 ☐ 100 or more

November 1992

90 96 98

Product Category Information	Disks & Optical Drives	7	Multimedia	19	Educational	30	Shareware	42
	Diskettes/Duplicators	8	Printers/Plotters	20	Engineering/Scientific	31	Software Duplication	43
	Fax Boards/Machines	9	Programmable Hardware	21	Entertainment	32	Spreadsheets	44
	Graphics Tablets/Mice/		Scanners/OCR/Digitizers	22	Graphics	33	Unix	45
	Pen Input	10	Tape Drives	23	Macintosh	34	Utilities	46
	Keyboards	11	UPS	24	Mail Order	35	Windows	47
	LAN Hardware	12	Software		Mathematical/Statistical	36	Word Processing	48
	Laptops & Notebooks	13	Business	25	Miscellaneous Software	37	General	
	Mail Order	14	CAD/CAM	26	On-Line Services	38	Books/Publications	49
	Memory/Chips/Upgrades	15	Communications/Networking	27	Operating Systems	39	Recruitment	50
	Miscellaneous Hardware	16	Data Acquisition	28	Programming Languages/		Miscellaneous	51
	Modems/Multiplexors	17	Database	29	Tools	40		
	Monitors & Terminals	18			Security	41		

Inquiry Numbers 52-233

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

Inquiry Numbers 409-590

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

Inquiry Numbers 766-947

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

Inquiry Numbers 1123-1304

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

Inquiry Numbers 234-408

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

Inquiry Numbers 591-765

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

Inquiry Numbers 948-1122

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE
TNT MAILFAST
FRG/BOS/700252/MO1
P.O. Box 66
Hounslow
TW5 9RT
England

PLACE
POSTAGE
HERE



BYTE magazine

SOFTWARE

Borland Targets Windows Developers with Latest C++ Release

OTTHAR HANSSON

Borland C++ 3.1 is the latest release of the best-selling object-oriented development environment. In addition to the expected support for the Windows 3.1 API, Borland C++ purports to offer "all you need" to produce Windows applications. However, what you mostly need to develop Windows applications at the moment is *patience*, and Borland's integrated browsers and editors, fast compilation, and reusable code modules are all designed to speed the process for the Windows developer.

Development Environment

Borland has significantly extended the functionality of its Windows-hosted IDE (integrated development environment). The IDE now permits developing optimized Windows code under Windows and debugging multiple applications, such as DDE clients and servers. It also contains some of the features we've been waiting for in Windows development environments. There is a speed bar under the main menu bar, providing quick access to commonly used commands.

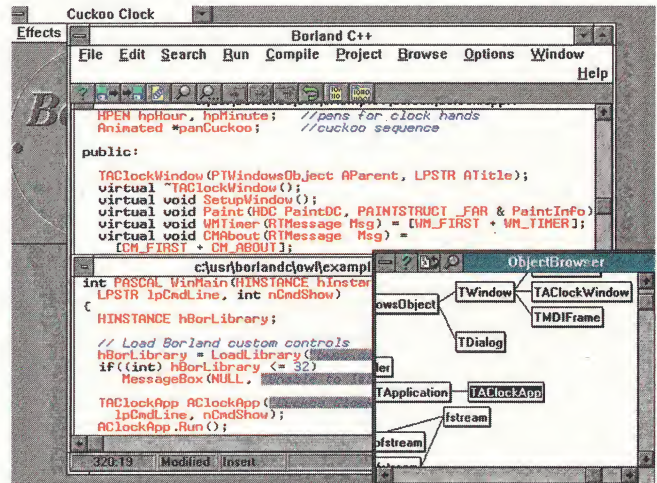
Most impressive is the context-sensitive editor. The editor provides cues for different elements of a program's structure, as in the screen's italic blue constant strings, boldface black keywords, and red function names. Colors and character attributes are user-defined, of course, and are available in both the DOS and Windows environments. Suitably garish colors can be assigned to catch unexpected characters and preempt some typographical errors.

In addition, the IDE features a graphical class browser, which provides an overview of the inheritance hierarchy. A double-click on a class brings up a scrollable list of class members. A speed-bar button brings up an editor window containing the class declaration. The browser is particularly useful in getting up to speed on a large body of existing code, such as the Borland ObjectWindows Library.

Language Lawyers

In contrast to Microsoft C/C++ 7.0 (see "Microsoft's Lucky Number," September

Borland's Windows integrated development environment now provides optimization options, an object browser, and a color-coded editor. The class definition being edited uses Borland's language extension to control Windows message handling.



BYTE), Borland C++ 3.1 is intended to comply with the AT&T Cfront 3.0 de facto standard. Microsoft C/C++ 7.0 (also known as C7) is based on the previous Cfront 2.1 release. As more publicly available code and widely read books begin to rely on Cfront 3.0 syntax and features, this will be an advantage to Borland users.

Borland also achieves better marks on C++ compiler validation suites, such as Plum-Hall and Perennial. Of course, this latest-generation compiler retains the ability to compile Kernighan-Ritchie or "classic" C code, with appropriate warnings. Borland C++ 3.1 implements the Cfront 3.0 template mechanism. Templates permit the specification and instantiation of generic classes. Common examples are the container classes: lists, queues, stacks, and so on. Templates make it convenient to declare two classes to represent lists of integers and lists of employees (assuming there is an employee class).

More important, the list template contains a single copy of the code for lists, simplifying maintenance and debugging. In contrast, Microsoft C7 provides a simple macro-preprocessor for achieving results similar to those of templates. By using a preprocessor, the Microsoft mechanism is more flexible, in that template arguments (e.g., integer and employee) can be used in preprocessor directives: This is because there are two preprocessor phases. However, this permits the development of code that is unlikely to be supported under future standardizations of templates.

Borland C++ 3.1 does not implement the exception mechanism that has been discussed by the ANSI X3J16 C++ standards committee. Microsoft C7, in a questionable implementation of the proposal, uses a simple `set jmp/long jmp` mechanism to modify the call stack when an exception arises. The problem with this is that destructors, which normally would have been called during procedure call returns, are not called as the stack is unwound. This can leave data structures in an ambiguous and volatile state.

Windows Message Handling

Language designers, as a rule, ignore I/O and other such "implementation details," as anyone who has ever internationalized a C program or handled I/O in Pascal can attest. C++ seems to be suffering a similar tale of woe in the area of GUIs. For example, one major motivation for the interest in applying object-oriented languages to the implementation of GUIs is the ability to have class-specific GUI event-handling (or message-handling) routines and to subclass by changing only a few event handlers. Sample events include mouse-clicks, window exposures, and window resize requests.

Unfortunately, because of the large number of events that must be handled, each class incurs the high space and time penalty of lookup in a large virtual-function table. Both Microsoft C7 and Borland C++ provide a way to work around this problem. Microsoft uses a clever macro

scheme to define and implement a single message-handling routine using a sparse table. Borland provides the much simpler mechanism of annotating member function declarations with the set of messages that they will handle.

Unfortunately, this is a Borland-specific extension to the C++ language standard. Although this has enraged the language lawyers, it seems to me to be a fairly insignificant practical issue. Maybe some fear that Borland, like the proverbial 700-pound gorilla, will do whatever it wants with the language standard in the future (remember pre-Turbo Prolog?).

In addition, there are many more significant hurdles to portability: The Borland extension seems to be convertible to

C7 with a simple script. Furthermore, the time spent in tying events to event handlers is minimal compared to the rest of the software development process—for example, in the X Window System toolkit, many such event “translations” can be defined by the user at run time.

Precompiled Headers

In Windows applications, which are built on deep hierarchies of type and class declarations, the unnecessary recompilation of “-h” header files is a significant overhead cost on each source file. Borland C++ 3.1 uses precompiled headers to speed recompilation, relying on the fact that declarations in header files typically change much more slowly than the corresponding definitions in source files. Headers are compiled automatically (based on a user-settable option) and recompiled when necessary. Borland does all the bookkeeping for you. Microsoft C7 requires specification of a file that contains the precompiled headers. Even though the headers may have changed, you can still use the old precompiled headers. Needless to say, this could be confusing.

Microsoft claims several other advantages in this area, which on second thought appear to be either rarely useful or achievable by other means (e.g., in-lining). Programmers may reserve the right to care about code generation and optimization, but they shouldn't have to care about how to optimize compilation at this low a level, and thus Borland's approach seems more workable. In fact, I hope that such techniques will evolve into incremental recompilation and linking, where a change to a single declaration in a header file will cause recompilation of only those functions that use that declaration (as in Lucid's Energize system for Unix C++ development).

Application Frameworks

Borland's OWL (ObjectWindows Library) provides a significantly abstracted object-oriented interface to the Windows API. There is little change from the 3.0 version of OWL. While Microsoft Foundation Classes are based directly on the structure of the existing Windows API, OWL provides building blocks such as built-in file and editor windows with automatic scrolling. If OWL is deep in some areas, then Microsoft Foundation Classes are broad.

Of course, the wonderful thing about class libraries is that one can compile and use the Microsoft Foundation Classes library within Borland C++. The Borland C++ 3.1 package also includes the Resource Workshop, an integrated tool for specifying the menus, dialog boxes, string

constants, and bit maps that form the look and feel of an application, and for modifying these resources within an existing application. Also in the package are WinSight (an improvement on the Microsoft Software Development Kit's Spy program) for tracing Windows messages and displaying window hierarchies, and WinSpector (analogous to Microsoft's Dr. Watson) for trapping and analyzing UAs (unrecoverable applications errors).

Borland continues to provide support for DOS developers. In addition, many developers will continue to build Windows applications under DOS, using either the DOS IDE or their favorite editors, make files, and the stand-alone Borland compiler. TurboVision complements OWL, providing an application framework for DOS. TurboVision provides classes to support development of event-driven, mouse-and-menu-based applications for DOS, including built-in editor windows and other modules. DOS overlay management, allowing the use of extended memory, is handled by VROOMM, as in previous versions of Borland C++.

Comparisons

There are many other differences between Borland C++ and its main competitor, Microsoft's C7. For example, Borland C++ has advantages in the area of using the power of C++ in DLLs: The OWL itself can be placed in a DLL and shared by several applications (offsetting the size of the library). Other compilers have advantages over the front-runners in 386 support, debugging, or optimization. These and other differences underscore the importance of head-to-head comparison on your project before choosing or switching among the many strong development environments out there, particularly if you have a large body of existing code that you need to work with.

Microsoft has some innovations in C7 (its first C++ compiler). But with several major releases over the past few years, Borland has been a consistent leader in innovation and ease of use in development environments. Borland C++ 3.1 continues this tradition. Its interface and ease of use make it the obvious choice for new C++ programmers, and its stability and portfolio of features make it a serious candidate for the experienced C++ programmer. ■

Othar Hansson is vice president of Heuristics Research, Inc., a software R&D firm in Berkeley, California. He received his Ph.D. in computer science from the University of California-Berkeley, and he has been a C++ user since 1986. He can be reached on BIX c/o "editors."

BYTE ACTION SUMMARY

■ WHAT BORLAND C++ 3.1 IS

The latest release of Borland's popular object-oriented development environment.

■ LIKES

Support for the Windows 3.1 API; integrated browsers and editors; ObjectWindows Library; extended Windows-hosted IDE functionality; and faster compilations.

■ DISLIKES

Borland deviates from the language standard in Windows message handling and fails to support exception handling.

■ RECOMMENDATIONS

Borland C++ 3.1's interface and ease of use make it the obvious choice for new C++ programmers; its stability and features make it a serious candidate for the experienced C++ programmer as well.

■ PRICE

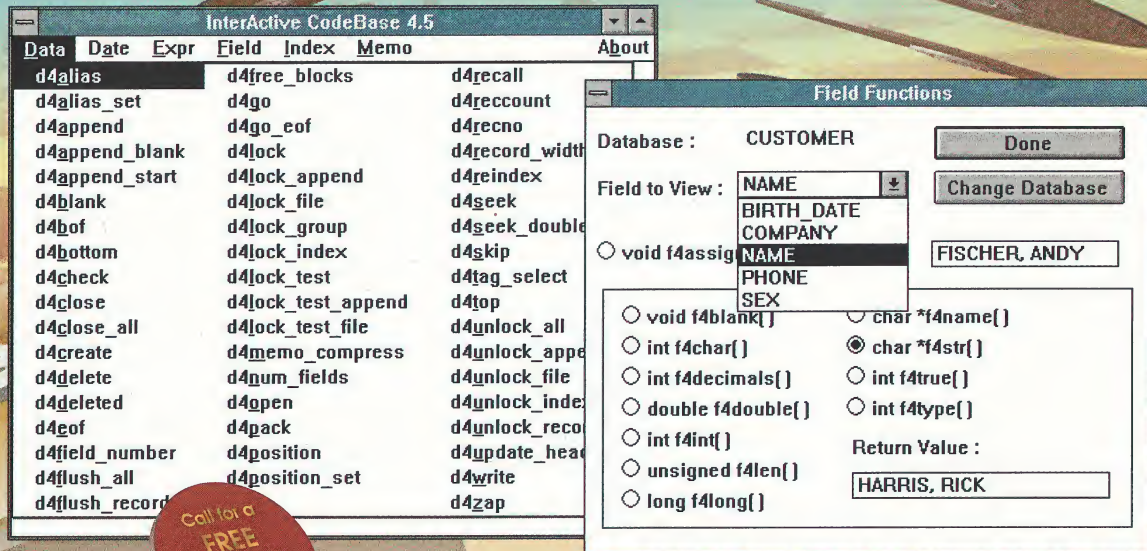
\$495

■ FOR MORE INFORMATION

Borland International, Inc.
1800 Green Hills Rd.
Scotts Valley, CA 95067
(800) 331-0877
(408) 438-8400
fax: (408) 439-8088

Circle 1221 on Inquiry Card.

dBASE, FoxPro and Clipper in C, C++ and Basic



- Multi-user
- DOS, Unix, OS/2 Support
- C++ Interface Included
- Windows 3 Data Entry
- Clipper → C Translator Available

Complete DBMS for C, C++ and VB programmers - compatible with the data, index and memo files of dBASE III/IV, FoxPro 2 and Clipper. Try the super-fast, super-small FoxPro 2.0 CDX index files!



(Using Visual Basic? Try CodeBasic!)

CodeBase 4.5

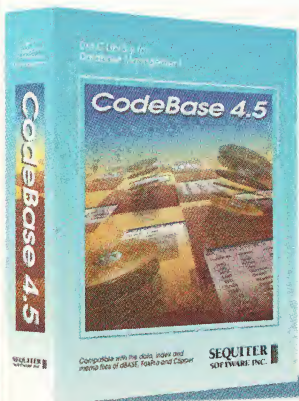
The C Library for DataBase Management

SEQUITER
SOFTWARE INC.



TEL. 403•437•2410
FAX 403•436•2999
Europe 33.20.24.20.14

#209,9644-54 AVE., EDMONTON, AB, CANADA T6E-5V1



APPLICATION

Sophisticated Graphing Under Windows

D. BARKER

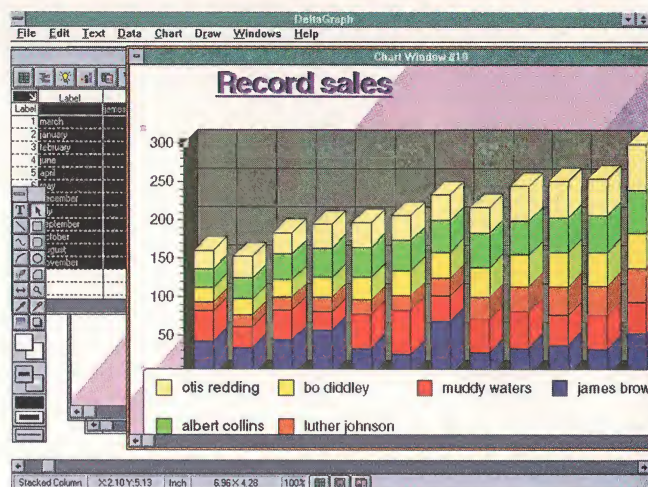
If you think the charts drawn by your spreadsheet program look like something you'd find on the wall of a cave, then take a look at DeltaGraph Professional for Windows. DeltaPoint's program has been one of the finest technically oriented charting packages on the Macintosh. Now many, but not all, of these features are available to Windows users.

DeltaGraph can quickly turn a flat chart into a slick and colorful graphic suitable for presentation. The default charts are fairly mundane, but you can easily enhance them with depth, color tints, shadowed text and objects, gradients and shades, illustrations, logos, and slick backgrounds. The bar chart in screen 1, for example, took only minutes to create.

But this program is not just for people whose primary concern is snazzy visuals. Besides basic calculation functions that businesspeople need, DeltaGraph offers data analysis that can serve statisticians and others working in technical, number-intensive fields.

Nevertheless, the Windows product is

Screen 1: *It took only a few minutes to turn worksheet data into this 3-D stacked column chart. It's easy to change any of the elements, each of which is a separate object.*



not without flaws. I found it to be much slower than its Macintosh counterpart. Also, DeltaGraph for Windows had an annoying penchant for redrawing entire screens after I made only minor changes, which added even more time to the creation process. Overall, however, the package brings excellent charting capabilities to Windows users.

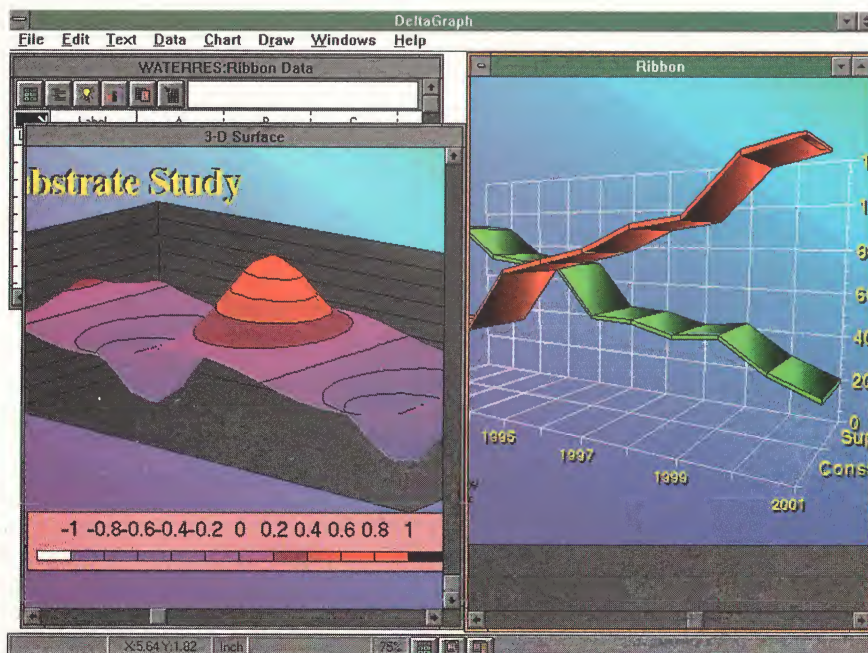
The first thing that DeltaGraph Profes-

sional has over spreadsheets and presentation programs is a bigger collection of chart and graph types. Most of today's spreadsheets and slide-making programs can do 3-D charts, and a few, like Informix's Wingz and 3-D Visions Corp.'s Stanford Graphics, can do some technical-type graphs. But none has the range of options that DeltaGraph offers. (This could change with the arrival of Stanford Graphics 2.0, which wasn't yet shipping at the time of this review.)

The package comes with 40 basic chart types. These include 2-D standards like column, bar, and pie charts, in regular or stacked format; contour charts, with either two or three axes; text charts; tabular charts; and more esoteric types like bubble, spider, and triangle charts. For people in scientific and technical jobs, there are true x,y,z-coordinate charts, double-y and double-x charts, and a variety of 3-D formats, including wireframe, surface fill, ribbon, and scatterline charts (see screen 2). The program can also do curve fitting and error bars.

Getting data into DeltaGraph is easy. You can use the program's spreadsheet-like notebook window and type in the numbers yourself, or you can import numbers from another program. DeltaGraph can take in data from just about any application, including Lotus 1-2-3, Quattro Pro, and Excel, as well as common formats like dBase, DIF, SYLK, and delimited ASCII. Using DDE and OLE, you can link to other Windows programs (DeltaGraph can work as both an OLE client and server).

DeltaGraph can import just about any



Screen 2: *This 3-D surface graph and ribbon chart are examples of DeltaGraph's 40 different types of data graphics. The ribbon chart shows the program's shading capabilities.*

kind of common graphics file: EPS, TIFF, PICT, PCX, AutoCAD, HPGL (Hewlett-Packard Graphics Language), CGM, Windows metafiles, and Windows bit maps. Harvard Graphics charts can be brought directly into DeltaGraph. Similarly, DeltaGraph charts and objects can be exported in those formats. Everything won't necessarily look the same when opened up in another application, however; for example, HPGL does not handle perspective text.

The Windows version can swap files with the Mac version. You'll need a Mac with a SuperDrive to read the PC disks, or a network connection to ship files back and forth; I used both methods successfully. Only once did I hit a snag: A Mac file I brought in over the LAN was missing half its graphs. Somewhere between the Mac and the PC, four graphs disappeared. Otherwise, compatibility appears solid.

Want Some Advice?

After you've got the data into the notebook page, all you have to do is press the plot button and then pick the kind of chart you want. A preview of the chart shows up in a little window. By clicking on the names of different chart types, you can see what each looks like. If you're not confident that you can pick the best type of chart or graph, you can call on the Chart Advisor (see screen 3). This is a mini expert system designed to suggest the best graph according to the number of data points, whether the audience is "scientific/technical" or "business/finance," and whether you are trying to show a trend or comparison. The advisor makes reasonable sug-

gestions; as with any advice, you can ignore it if you like.

In DeltaGraph, every element of a chart or graph is a customizable object. In order to change the color of a bar, for example, you just select it, then call up the color palette and pick the color you want, and the change is made in the chart. The same goes for styling text, backgrounds, legends, labels, and so on. DeltaGraph's artistic capabilities are extensive—besides fancy gradient fills and color-mixing tools, the package incorporates basic Bézier drawing tools—so a person with good visual sense could use it to render very attractive data graphics.

Formulas and Functions

Besides its technical charts, DeltaGraph's calculation tools help it surpass programs like Aldus Persuasion and Harvard Graphics. If you need basic data analysis, like figuring the frequency of certain values, DeltaGraph has a component for building formulas. Working within a dialog box, you click on functions, such as Avg(), Diff(), and Freq(), select source columns, and pick operators by pushing buttons.

The program isn't meant to be a full-blown analysis package—it supports 50 data functions, compared to Microsoft Excel's more than 300—but it's got sufficient functionality to handle many types of mathematical and statistical problems. In fact, statisticians represent a prime target market thanks to the calculation capabilities and technical charts.

Good Variety of Output

DeltaGraph can send files to PostScript or GDI (Graphical Device Interface) printers, which covers just about any output device you're likely to want to use, including color laser printers, film recorders, and plotters.

You can also print a PostScript file to disk, so you could send it off to a service bureau for high-resolution printing.

A Funny Thing Happened on the Way to the PC

Despite its benefits, the Windows version of DeltaGraph isn't as good as its Mac counterpart. The most noticeable difference is speed. Generating a fairly typical graph—a 3-D stacked-column chart representing 12 months of sales for six recording artists (similar to the one in screen 1)—can take as much as 2 minutes on a

33-MHz 386. On a "comparable" Mac, the same job takes 13 seconds. In fact, the Mac version generally renders a chart in less than 10 seconds.

DeltaGraph for Windows' mania for redrawing is even more tiresome. If you make a change to a chart, the program usually redraws the whole thing, as well as anything visible in other windows. This isn't so bad with plain charts, but it gets tedious with complex graphics. The program first redraws the background, then the grid,

BYTE ACTION SUMMARY

■ WHAT DELTAGRAPH PROFESSIONAL FOR WINDOWS IS

A program for producing presentation-quality charts and graphs.

■ LIKES

Great-looking charts; wide variety of charts and graphs; ease of learning and use.

■ DISLIKES

Redrawing is tedious and much too frequent; performance is sometimes pokey.

■ REQUIREMENTS

Microsoft Windows 3.x, 2 MB of RAM, at least 5 MB of hard disk space (complete installation takes 22 MB), and EGA graphics at the least; a fast 386 or 486 is highly recommended.

■ RECOMMENDATIONS

If you're a Windows user and need to produce good-looking data graphics for presentations, buy DeltaGraph.

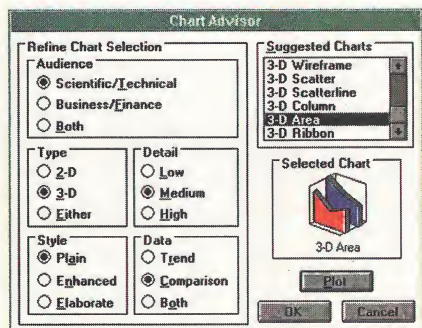
■ PRICE

\$295

■ FOR MORE INFORMATION

DeltaPoint, Inc.
2 Harris Court, Suite B-1
Monterey, CA 93940
(408) 648-4000
fax: (408) 648-4020

Circle 1226 on Inquiry Card.



Screen 3: If you tell the Chart Advisor a few things about the kind of chart you want—target audience, for example—it will make suggestions.

then the chart itself, then any illustration material, and then the labels and legends. Every time you scroll down, for example, the program redraws everything on the screen. If you close one window, the program redraws everything on the screen. One unattractive way around it is to think ahead and try not to make many changes.

The program also has a bothersome way of closing windows. Instead of just clicking on a button in the top left corner of the window frame, you have to go into the File menu and pick Close or go into the Chart menu to delete it. Not a flaw, really, but people who use Windows regularly will find this takes some getting used to. (With the Mac version, the close button works the way it does in every other Mac application.)

Also troubling is DeltaGraph's handling of backgrounds. You draw a background in one window and then apply it to the chart in another window. But the background window stays up on the screen (one more thing to be redrawn), so you have to put it behind the chart window. I guess this is so you can get to it quickly if you want to make changes. I don't like calling up a file and seeing the background window some-

times coming on top, obscuring the related notebook page and chart window. Chances are you're going to want to work with the chart or the data worksheet rather than the background, so it's strange that the background window gets prominence.

Version 1.0 shows that there are still a few kinks to be worked out, including UAEs (unrecoverable applications errors). Other problems are inconsistencies with text. In one chart, some of the labels came up boldface, some didn't. I selected them all and changed the style to bold. Only some of them came out bold. In another chart, some of the text came up 24-point shadowed, while the rest came up 14-point plain. Other times I found typos in labels; they weren't there in the text on the worksheet page. You can fix all these things, but you shouldn't have to.

The Best Graphing You Can Get

DeltaGraph is used by some serious chartmakers, including *The Wall Street Journal*, Eastman Kodak, Boeing, Lockheed, and DuPont. There are reasons for that. It has a wide choice of chart and graph types, particularly technical graphs; an excellent set of graphics tools; an adequate suite of

data-analysis functions; good support for output devices, including high-resolution devices; and now, compatibility between Windows and Mac environments. Plus, it's very easy to learn and use.

It's got flaws and quirks, most of which were acquired in the migration to Windows. But these are not serious flaws. I found no evidence of errors when turning numeric data into visual form. Despite a few idiosyncrasies, DeltaGraph is the top choice for a Windows charting program. Unless you need it today, though, I would recommend waiting for the next (maintenance) release. By then, DeltaPoint will have ironed out the quirks and oddities.

If you're happy with the charts you can crank out with your spreadsheet program, or if you're content using Quattro Pro to do presentations, then you probably won't appreciate DeltaGraph. But if you're working with statistical or scientific data and need to present it in a visually appealing way, check out this program. At \$295, it's an excellent value. ■

D. Barker is a BYTE Lab technical editor covering applications software. He can be reached on BIX as "dbarker."

AiTech

ProPC/TV

COMPUTER TO TV CONVERTER DEVICE

AMAZING!

Aitech International... the innovative leader in multimedia and desktop video has gone and done it again!

ProPC/TV is the world's finest and most cost effective external device used to take computer text, graphics and games and allows you to show them on your TV screen.

THE BETTER SOLUTION

Every notebook or portable computer user knows the disadvantages of using their monochrome display. Aitech's ProPC/TV provides a better solution to the high cost of large screen monitors.

AiTech

Vision for Multimedia

EFFORTLESS INSTALLATION

ProPC/TV is about the size of a cassette tape case, weighing just a few ounces. It installs quickly and easily, and comes with all required cables.



Call an Aitech sales representative today for more information about the ProPC/TV.

830 HILLVIEW COURT, SUITE 145, MILPITAS, CA 95035 1-800-882-8184

While Our Competitors Are Diligently Trying To Emulate The SummaSketch® II...

We Proudly Announce SummaSketch II *Plus*

The world's best selling, most emulated, most acclaimed desktop tablet just got better. We've taken SummaSketch II, the industry standard, and added several new features to create a tablet that is, unquestionably, the world's best.

Unlike some competitors, we put everything in the box—4-button cursor and 2-button stylus (or 16-button cursor), interface cables and a utilities diskette with Windows® 3.0 and ADI® drivers. Plus we've added things like 2000 lines per inch resolution and 10 mil accuracy—standard. Plus the fastest, easiest set-up and configuration procedure. Plus an offer for a free AutoCAD® or CADKEY® Master Template (a \$245 value). Plus software compatibility



with over 400 programs, and hardware compatibility with PCs and Macintosh®. Best of all, it's still 100% pure SummaSketch—the editor's choice, winner of every major editorial accolade for graphics tablets. And the people's choice, with well over one-half million sold to demanding computer graphics professionals.

**Every
decision**

should be this easy. In fact, the only tough decision is which Plus to choose: 12" x 12" or 18" x 12" Professional. For literature, or the name of your local dealer, call 1-800-729-7866. For technical information call 203-881-5400.



Summagraphics®

Every decision should be this easy.™

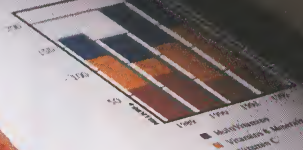
The best place to get your photos printed.

You don't need a photo lab to get output like this. A Phaser™ II SD color printer by Tektronix will do just fine. It's the only dye sublimation printer that gives you detailed, photorealistic images with crisp, clean text—that's TekColor Photofine technology. But you also get PostScript™ Level 2 and TekColor PS to match and adjust colors. Plus Pantone certification, networkability, a 24MHz RISC processor for speedy output, a \$9995 price tag and a print cost of about \$2 per page. All in one little machine. So much for that hut in the middle of the parking lot. Call the leader in color printers at 1-800-835-6100 Dept. 25J for a free output sample. Or call (503) 682-7450, ask for Document 1222 and we'll send information by fax.

Tektronix
Computer Graphics

Unified Healthcare Incorporated

Children's vitamin sales



Phaser is a trademark of Tektronix, Inc.
Postscript is a trademark of Adobe Systems, Inc.
All other marks are trademarks or registered trademarks of their respective companies.

Circle 202 on Inquiry Card.

MULTIMEDIA

Style Meets Substance in Matrox Studio

TOM YAGER

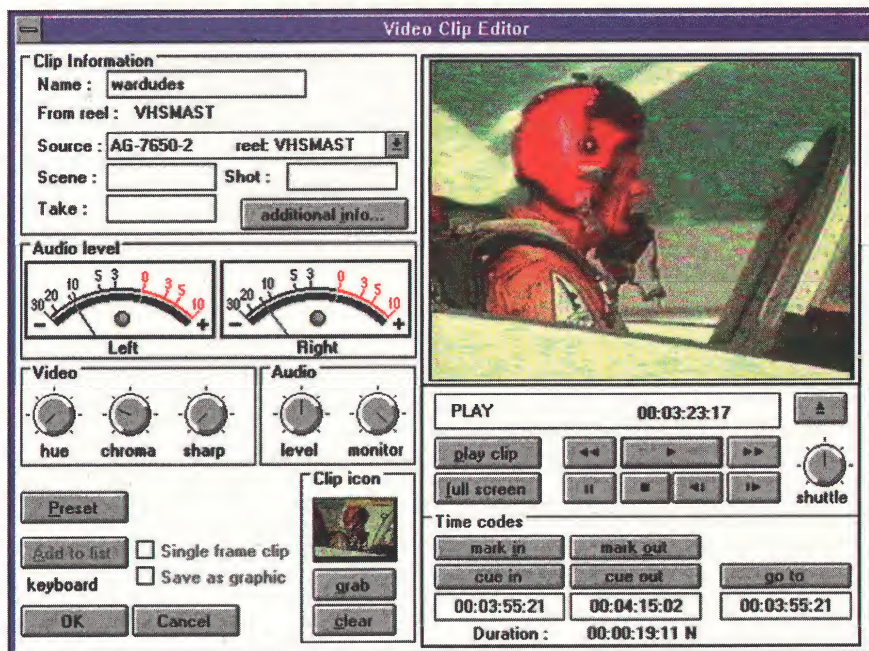
If anything typifies the business environment of the 1990s, it is that we all have more information to deal with and less time in which to deal with it. The same is true for our coworkers, managers, employees, and customers. In this rushed, competitive atmosphere, the *packaging* of ideas for efficient delivery is becoming as important as the ideas themselves.

There is no medium that combines the ideals of high information density, easy and inexpensive delivery, and image-enhancing power as well as video. One of multimedia's most exciting benefits is the spread of video capabilities from the exclusive domain of Madison Avenue types and pricey video production houses to the hands of general business users. Computers are speeding that movement by lowering costs and hiding the complexity of video technology.

A milestone was passed about two years ago when Newtek introduced the amazing Video Toaster (see "Newtek's Video Toaster Makes Professional Video Affordable," March 1991 BYTE). It established standards for value, output quality, and ease of use that stand today. Now, an exciting new product from Matrox Electronic Systems called Studio promises to raise these standards, putting professional video production power in the hands of corporate communicators, businesspeople, and all those whose livelihoods depend on having their ideas and products understood and adopted.

The abridged description of Studio calls it a PC-based video-editing system. What makes Studio unique is its incredible completeness. In one package come all the hardware, software, cables, and connectors you need to create your own professional-quality videos; all you have to add are VCRs. You can blend computer-generated graphics and titles with your video, add broadcast-quality digital video effects, and use the automated, computer-controlled audio mixer to manage the audio portion of your production. All this power comes together under an unimposing Windows user interface; you can literally go from a blank screen to your first professional edit in 10 minutes.

I have to place some emphasis on the word *professional*. Studio's price tag of \$14,000 may strike some as extravagant.



Studio's video clip editor. This interface lets you interactively mark a section of video and turn it into a "clip" that you then combine with other clips to create a finished video production. Every aspect of Studio's video and audio hardware is software-controllable, and much of that control comes together in this one densely packed but comfortable interface.

But anyone who has looked into the costs of the components of an in-house video production system knows that Studio, while no drop-dead bargain, is a good deal.

For \$14,000, Studio gives you an eight-input video switcher with digital effects; a six-channel computer-controlled stereo audio mixer with DSP (digital signal processor) digital audio; a 32-bit frame buffer for computer graphics; three channels of time-base correction for video synchronization and quality enhancement; and VCR control for up to four decks. (Studio can be purchased in less expensive configurations, including a \$9995 version without the audio mixer and time-base correction.) You needn't invest in costly additional components, and Studio doesn't require you to have the kind of expertise typically needed to purchase and set up a video production system from scratch. All you need is a little creativity and the desire to take control of your own presentations.

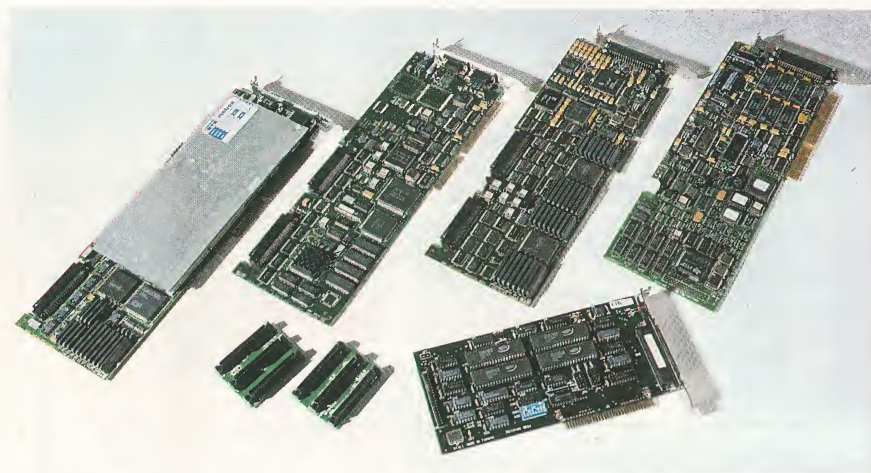
I tested Studio using a Media Resources/PC Craft 486-50 EISA system equipped with 8 MB of memory. I used two Panasonic AG-7650 Super-VHS playback

decks as sources, one AG-7750 recorder, and a BT-M1310Y professional video monitor. I also used a Truevision ATVista graphics board and software from AT&T Graphics Software Labs to create some of the graphics and animation sequences used in these tests. Studio requires Windows 3.1; its drivers install under the Multimedia Extensions, and the editing software is a native Windows application.

Call 1-800-Cable-Me

Studio's hardware side consists of five PC boards (four ISA and one EISA), three of which are tied together with a rigid bus connector (see the photo). You'll also find an astonishingly complete collection of cables, connectors, and adapters. Having configured video systems with makeshift cables many times, I cannot overemphasize the value of having everything included, complete with labels.

Studio's video inputs are versatile. The cable set has four S-Video (most often associated with the higher-resolution Super-VHS and Hi-8 video formats) inputs. One or more of these can be converted, using



Studio's hardware consists of five boards (four ISA and one EISA). The first three (working from left to right) handle video, and they communicate with each other via a set of bus sockets along the top of the boards. The fourth is the DSP-based audio processing board. The smaller board below the others is the four-port RS-422 VCR controller.

supplied adapters, to transform a single S-Video connection into two composite video connections. In that way, Studio supports four to eight inputs; you can mix S-Video and composite inputs however you like. It's most beneficial to use S-Video inputs for those devices that support it and to run your entire system on S-Video if possible, since that improves the overall quality. Four external S-Video sources are enough for the most demanding projects.

The VCR control runs through a four-port RS-422 serial card. You don't have the option of using a camcorder or an inexpensive consumer deck; Studio requires

high-quality editing decks, but with the cost of this gear declining, it's hardly a heavy burden. Besides, you wouldn't want to hobble Studio with consumer video equipment; you can only expect professional results if *all* your components measure up.

Studio's Triplecast

Studio takes advantage of brand-new application-specific-IC technology, developed at Matrox, Philips, and elsewhere, to create something that's never existed in a PC before. This technology gives you three independent channels of video that you

can combine virtually any way you like. You can switch any of the eight video inputs into this three-channel virtual bus, and you can also use Studio's internal graphics frame buffer as a video source.

Obviously, you can't just throw three video signals onto a screen at once. Each channel has its own digital processing unit. Each unit operates independently of the others, contributing to your output in the way you define. Video can be resized in real time. Making video smaller creates window or picture-in-picture effects, while making video larger than full-screen creates a zoom effect. A video channel can be positioned anywhere, regardless of its size—even completely off the screen.

To get to the screen, the video must pass through Studio's effects unit. This decides which of the three channels actually shows on the screen, and how. For transition between two full-screen video sources, you can wipe, dissolve, or slide one source over another. Video windows can be transitioned in and out without disturbing the underlying video. Among the most intriguing of the effects are those that apply the digital keyer.

Studio's keyer lets you "stack" video channels, with the content of the image in selected channels determining what the output will look like. For a simple example, let's say you wanted to add a quick title to some video. You'd create a simple title graphic: white characters on a black background. You would then switch Studio's keyer into luminance (brightness) mode. A luminance keyer analyzes a video signal and turns everything within a certain brightness range transparent. With a little adjusting, the black background would become transparent, leaving the white title characters in the foreground, "floating" above the video underneath. You just created a video overlay.

If you wanted to use a graphic that had more color, you might use Studio's chroma (color) keyer. This lets you choose a range of colors (instead of brightnesses) that will become transparent. Alpha keying works with still graphics created in software that uses Studio's 8-bit alpha channel. This allows portions of a still image to take on any of 255 degrees of transparency, from opaque to filmy to invisible.

Studio's Ultimatte key mode uses the blue component of a graphic to determine transparency, useful for creating semi-transparent graphical effects in software that doesn't support the alpha channel. While I used still images as examples, most of Studio's key modes can be used with moving video as well.

Finally, a quick note or two on the audio board (referred to as the Virtuoso board). *continued*

BYTE ACTION SUMMARY

■ WHAT MATROX STUDIO IS

A combination of PC hardware and Windows software for professional-quality video editing.

■ LIKES

Includes everything but the video decks and monitors; comfortable interface; ingeniously versatile hardware design.

■ DISLIKES

The keyframer used for nontransitional video effects should be easier to use and more automatic.

■ RECOMMENDATIONS

A well-engineered, well-executed video-editing package. It gets my whole-hearted recommendation for those who do their own video production and who care about the quality of the results.

■ PRICE

\$14,000

■ FOR MORE INFORMATION

Matrox Electronic Systems, Ltd.
1055 St. Regis Blvd.
Dorval, Quebec,
Canada H9P 2T4
(514) 685-2630
fax: (514) 685-2853

Circle 1225 on Inquiry Card.

Here's how to...

DO MORE MATH FASTER, Easier, and More Accurately

Prove it to yourself FREE!!

New Mathcad 3.1 turns your PC into a "smart" math scratchpad, and you into a bona fide math expert. Mathcad 3.1 builds numeric and symbolic equations for you, then does the calculations and shows you the answers. Add graphics and text anywhere on your page for comprehensive, easy-to-communicate solutions to your math-related problems. Then print out what you see as presentation-quality documents, complete with math notation.

Mathcad 3.1 really is the breakthrough it sounds like. But don't take our word for it. See Mathcad 3.1 in action for yourself. Call right now for a FREE demonstration disk, and experience all this:

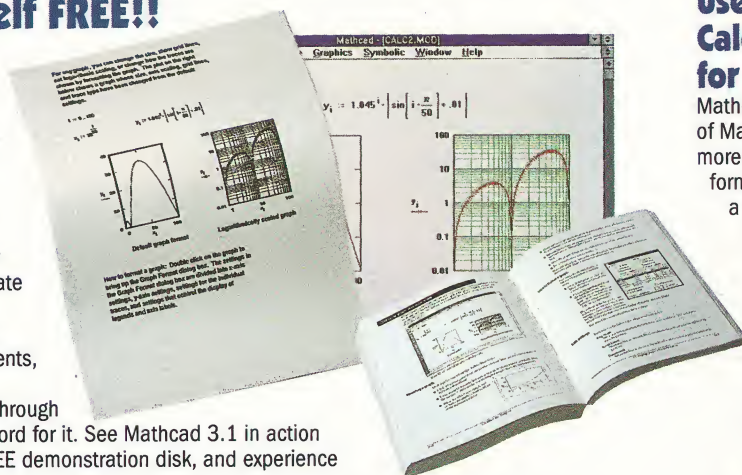
1 A Truly "Smart" Math Scratchpad

Click on icons to select any of 56 operators and symbols and they appear on the screen, complete with placeholders for the required operands. Use "drag-and-drop" mouse simplicity to move symbols around just as you would with pencil and eraser. Mathcad 3.1 even reads your equations for variables you did not define, and gives you context-sensitive Help to fix errors. Type the "=" sign, and Mathcad performs your calculations instantly. You think creatively while Mathcad 3.1 backs you up by doing all the routine tasks and instant calculations.

Mathcad includes a full complement of sophisticated functions including Fast Fourier Transforms (FFT), Bessel functions, statistical functions, eigenvalues, eigenvectors, and more. Manipulate vectors and matrices by doing matrix addition, subtraction, dot products, integer powers, inverses, and determinants. You can also carry out symbolic operations with matrices.

Ready-Made Solutions at the Speed of Light

Mathcad offers optional customized tools for your specific field, for example, Electrical Engineering, Mechanical Engineering, and Civil Engineering to name a few (there are 15 Mathcad tools already available). In a split second, you can get a complete on-screen discussion and explanation of a topic in which you are interested. You get formulas, methods, facts, and diagrams for problems that you encounter daily. And they are interactive, so you can make modifications for specific calculations. Or double-click on a Handbook entry and cut-and-paste it directly into your document.



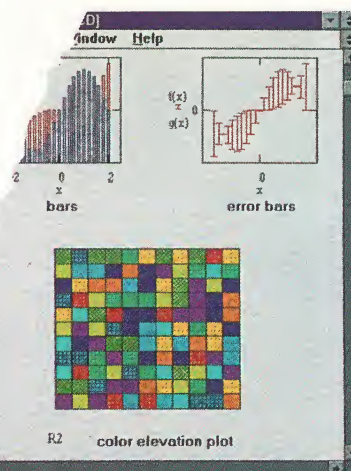
Use Symbolic Calculations for Greater Insight

Mathcad 3.1 has all the core functions of Maple's symbolic tools to give you more power to derive and simplify formulas. For example, pick from a menu to evaluate an expression symbolically or solve for a variable. There is no need to learn a programming language: just select and click. The symbolic answer is ready for numeric calculations or further symbolic transformation.

Explain Your Work with Graphics and Text

Click where you want a graph, then click again on the plot button. Fill in placeholders with your values. Change the plot type, size, etc. Then add type and grid lines with another couple of clicks. Add colors, legends and more just as easily. The result: informative graphs that communicate your conclusions instantly and clearly.

Complete your work with text using Mathcad 3.1's flexible word processing tools. It's the only program you need to document your solutions.



FREE Full Working Demo Disk...Call 1-800-MATHCAD Now.

Try our FREE, no obligation, demo. The Tutorial walks you through Mathcad 3.1 basics. It gives you 24 examples of interactive documents that you can load onto your hard disk. You'll be able to work with equations, text, and graphs to really experience what Mathcad is all about. Call 1-800-628-4223 or 617-577-1017. Or fax the coupon to 617-577-8829, or mail to MathSoft, Inc., 201 Broadway, Cambridge, MA 02139 USA.

☐ **YES!** Please send my FREE demo of Mathcad in the version I have indicated below.

MEDIA: (Please call for UNIX information)

- ☐ Mathcad 3.1 (PC Windows™)
☐ Mathcad 2.5 (PC DOS)
☐ Mathcad 2.0 (Macintosh®)
☐ 3 1/2" Disks ☐ 5 1/4" Disks

NAME _____

TITLE _____

CO./INST. _____

ADDRESS _____

CITY/STATE/ZIP _____

PHONE () _____

Please mail this coupon to:

MathSoft, Inc. 201 Broadway, Cambridge, MA 02139 USA 1-800-628-4223 617-577-1017

FAX 617-577-8829. For information on Mathcad distribution outside the US, contact MathSoft USA.

©1992 MathSoft, Inc. TM and ® signify manufacturer's trademark or registered trademark respectively.



**AVAILABLE FOR PC WINDOWS,
PC DOS, MAC AND UNIX**

Circle 148 on Inquiry Card.

B94B

UPGRADE TO V6.5
\$19.95 — 1-800-344-4323

Hard Drive Installation and Diagnostics



Made Easy.

Now, adding a hard drive to your system is as easy as typing "install." There's no need to know DOS or complicated commands. SpeedStor automatically performs all of the operations to make your drive "data ready." And to keep your drive "data safe," SpeedStor contains critical diagnostics not found in DOS — diagnostics that safeguard your valuable data and ensure your hard drive is trouble free.

Available at Best Buy, Egghead Software, Computer City Supercenter, CompUSA, Elek-Tek and Software Etc. Order today, call 1-800-344-4323.

 STORAGE DIMENSIONS

SpeedStor
Storage Installation And Diagnostic Software

SpeedStor is a registered trademark of Storage Dimensions.
©1992 Storage Dimensions

MATROX STUDIO

It's an MPC-compliant board, capable of digitizing and playing back audio at up to 44.1 kHz in 16-bit stereo. It also has an on-board music synthesizer and supports external MIDI devices. Virtuoso's mixer controls up to six stereo audio sources, with volume, balance, bass, and treble controls for each channel. Matrox used a general-purpose DSP, which will later bring digital audio effects to Studio.

The Soft Side

For all Studio can do, Matrox's programmers have done a marvelous job of wrapping that complexity in a friendly but not condescending application.

The main interface is the now-familiar collection/storyboard combo. Video segments, graphical images, and digital audio files are organized into "clips" and added to a collection by built-in Studio tools. The video clip editor (see the screen) puts up a comfortable interface on your VGA monitor that includes VCR controls, video and audio adjustment controls, audio VU (volume unit) meters, and a live video window. Creating a video clip is as simple as using the graphical VCR controls to find the segment you want and marking its beginning and end. Studio digitizes a frame of the video and turns it into an icon, displaying it in the collection.

Once you have clips in your collection, you create your video by dragging and dropping the clips onto the storyboard's time line. A graphic depicts the start, end, and duration of each clip. There are separate time lines for graphics, audio, and multiple video channels. Two special time lines—Audio M/E (mix/effects) and Video M/E—are automatically filled in as you drop clips onto the storyboard. You double-click on the icons on the M/E lines to change the default audio or video mixing. In the case of video, it's the Video M/E time line that controls the type and duration of transitional effects and determines which video channels get displayed.

You can take minute control over each video channel's processing unit through Studio's keyframe effects. These allow you to set starting and ending attributes and then have the software interpolate between them automatically. You could, for example, have a one-quarter-screen video window appear and then gradually grow to occupy the entire screen. You would only have to set keyframes for the size and position of the one-quarter-screen window and the full screen that followed it. Studio would determine the intermediate size and position changes needed to make the window grow as you requested.

The only unpleasant part of Studio for me was that the keyframe effects weren't

more automated. For example, you can create the effect of a video frame tumbling end-over-end into oblivion by using the keyframer, but it's an ordeal. A library of common keyframe effects, along with the ability to load and save new ones (a feature presently lacking), needs to be added.

At any point in the process, you can ask Studio to preview a portion of your storyboard. In fact, Studio is loaded with "preview" buttons so you can see how your choices will affect your finished video long before you commit them to tape. When you are ready to record, Studio lets you send either the entire storyboard or a selected portion of it to your recorder. If your production calls for tape changes, Studio will prompt you for them as needed. This means that you can get more mileage out of the equipment you have: Two source decks, with media changes, can serve the purpose of three or more.

Rewind and Eject

Studio is not the Video Toaster killer some might have been expecting. The Toaster still has the advantage of being usable in a live environment; Studio (its software, that is) can only deal with videotape and still images. The Toaster also includes 3-D animation, and its library of transitional effects is much larger than Studio's.

On the other hand, Studio has some things the Toaster doesn't: S-Video input and output, built-in time-base correctors, audio processing, VCR control, editing software, and video scaling top the list. Some of these can be added to the Toaster at no small cost (about \$9000). Prior to Studio's introduction, I did just that, and I'm very pleased with the results. Studio does not obsolete the Toaster; in the BYTE Multimedia Lab, they complement each other nicely. But of the two, Studio is clearly the better *editing* system, requiring less external gear, fewer connections, and fewer steps to a finished video.

If you're serious about doing your own video production, and you care about the quality of the results, Matrox Studio stands out as a well-engineered, well-executed video-editing solution. Software vendors are seeing this, too, since graphics packages like AT&T Graphics Software Labs' Topas and Rio and Autodesk's 3D Studio are being updated to include Studio support. I have no trouble giving Studio my most enthusiastic recommendation. ■

Tom Yager is director of the BYTE Multimedia Lab and author of The Multimedia Producer's Handbook (Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.

APPLICATION

LANlord Evicts LAN Problems

BARRY NANCE

LAN administrators sometimes need to handle problems that require knowing more than just the contents or destination of packets flying over the wire. Application-layer management involves topics that are so high-level they hardly seem to involve the network at all: tracking workstation hardware configuration, determining how many (or which) users are running a certain limited-license application, and making changes to system and Windows configuration files at selected workstations, to name a few.

All of these are tasks that can best be carried out by an administrator working from a central management console—the same network administrator who handles low-level cable management. But while there are a host of management packages that will give you all the physical-layer information you require, there are relatively few that provide the high-level (i.e., transport layer through application layer) data required for configuration and asset management.

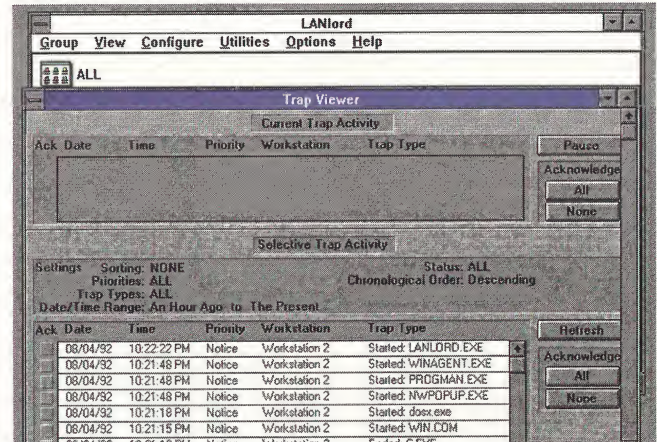
Microcom's LANlord 1.0 is the newest of these packages for NetWare 2.15, 2.2, and 3.11 LANs, and it's probably the most complete. In a single bundle, it gives you a software-metering module, a workstation-hardware-inventory module, a program-activity module, an alert-generating module, an alert-viewing module, and a remote-configuration module. In addition, Microcom promises to send you a virus detection and repair utility when you send in your registration card.

LANlord provides critical information, central management, and remote-editing capabilities, but unfortunately not without a little pain along the way. There are numerous configuration requirements and restrictions that make LANlord more difficult and less complete than such a package needs to be.

LANlord Architecture

LANlord is a client/server design. The server is an OS/2 machine that maintains a MIB (management information base) of over 200 objects detailing configuration and software-use information for each of its network clients. If the OS/2 server has to manage fewer than 20 or 30 clients and has enough horsepower, the LANlord server module can run as a nondedicated task un-

LANlord's Trap Viewer (Alert display) is part of the Windows-based LANlord Manager, LANlord's primary user interface.



der OS/2. However, the OS/2 machine must be dedicated to LANlord on busy networks.

The server's clients are LANlord agents that run on DOS and Windows PCs. These agents are the components that determine hardware configurations and monitor software usage. Clients communicate configuration information to the LANlord server at timed intervals over SNMP protocols.

The last component is the administrative module (LANlord Manager), which can run on any Windows 3.0a client on the network (see the screen). LANlord Manager is the administrator's "front end" to the LANlord server; it's where the administrator can monitor configuration information or perform administrative tasks.

Because of LANlord's structure, you need an interesting mix of hardware and software to get it up and running. The server requires a system running OS/2 1.21 or higher (I used OS/2 2.0). At least one workstation must run Windows 3.0a or higher (I used version 3.1). DOS workstations that you want to monitor must run a 19-KB agent TSR program, and Windows clients must also run a WinAgent program for monitoring Windows activity.

What LANlord Can Do

LANlord can track software usage, maintain an inventory of installed hardware and software, and give the administrator remote access to configuration files on each workstation. You access all these capabilities through LANlord Manager at your Windows management console; the information you work with is constantly updated by the clients in real time.

Software tracking meters software for licensing purposes and maintains a histo-

ry of program usage for each workstation. After you tell LANlord about the software licenses in effect for your site, LANlord monitors the number of concurrent users of that software. You give LANlord the title of the software, the drive letter and path, the number of licenses, and the time interval (in minutes) LANlord should use for recording concurrent access. LANlord generates an alert when someone on the LAN exceeds the license limit. If you don't specify the drive letter and path, LANlord tracks the usage of all copies of the specified application.

Besides showing usage statistics in numeric form, LANlord can display a graph of software usage. You can see at a glance if you need to buy additional licenses or, conversely, if you've bought software that no one uses. LANlord also shows the network administrator a history of programs run on each workstation. You can see this information for all workstations (sorted by workstation or by application) or for a single workstation; you can also specify a single application to keep track of where and when that application has been run.

LANlord's detection of installed hardware and software is thorough and provides useful information. You get the sort of information at the management console that you would see if you ran a utility such as Norton's SysInfo at the workstation. A Summary screen shows the workstation's basic hardware configuration. A Volumes screen gives information about the workstation's hard drives. The System Files screen lets you view configuration files. The Versions screen tells you whether the workstation's DOS and network software are up to date. You also get detailed

pictures of Windows activity (if appropriate), memory utilization, DOS open files and environment information, adapters (including I/O-port, interrupt-request, and DMA-channel assignments), and IPX/SPX network statistics.

Finally, the administrator can remotely edit a workstation's AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, SYSTEM.INI, and SHELL.CFG files. In addition, the administrator can, at his or her discretion, reboot the workstation after making these changes.

Alerts

LANlord provides configuration and usage information whenever you ask for it, but it can also generate alerts when certain conditions occur. A LANlord alert (Micro-

com calls them traps) can be critical, a warning, or just a notice. You can customize the category of each event and the color scheme LANlord uses for each category.

Alerts include a workstation joining or leaving the LAN, an unknown or incorrect workstation ID, a change in a workstation's configuration files, a workstation accessing a particular file, a workstation exceeding software license limits, the execution of a particular program, a user signaling for help, the detection of a virus, or the exceeding of a threshold you've set for that workstation. You can set threshold limits on quantities, including free disk space; available Windows GDI (graphics device interface) Heap or User Heap; or IPX or SPX errors.

LANlord in Action

Installing LANlord can be quick and easy if you already have OS/2 and Windows workstations on your LAN. As you set up LANlord, you can assign workstations to various logical groups; these groups may match the network's physical layout (e.g., the third-floor group) or more intangible organizational quantities (e.g., authorized Excel users). You can establish different monitoring parameters for each LANlord group.

I exercised LANlord on my LAN at home and at the office. Both networks are NetWare 3.11 environments with a mix of OS/2, pure DOS, and DOS-and-Windows workstations—both perfect matches for LANlord. I put all my applications, even shareware registrations, under the scrutiny of LANlord's software metering. I was able to verify over the course of several days that I'm not using unlicensed software. Before I updated the licensed-software list, LANlord dutifully alerted me to the supposed transgressions as I used each unlisted software product.

I found the hardware and software inventory supplied by LANlord complete and accurate. LANlord supplies a wealth of information, including even such things as CMOS configuration. I kept a log to check LANlord's program-monitoring functions; LANlord's history of programs run at each workstation echoed my handwritten list exactly. I also found LANlord's remote configuration and alert features very convenient.

Early Quirks

This is LANlord's initial release; the first version of any software product is bound to suffer from restrictions and limitations that disappear in later versions. But LANlord imposes some restrictions on your LAN that you may not be willing to live with. To Microcom's credit, the developers know

about these drawbacks; the README file mentions many of them.

LANlord uses a SAP (service access point) provided by the Novell OS/2 NetWare Requester. The current OS/2 NetWare Requester doesn't support multiple SAPs, so you can't run any other SAP application on your LANlord server. In particular, the OS/2 machine can't be both a named pipes server and a LANlord server. If you have an intelligent hub, bridge, or router on your network that filters NetWare SAP packets, the LANlord packets will fall into the bit bucket. You need to configure such devices to pass NetWare SAP packets, if the device can be so configured.

Microcom says LANlord may fail in the presence of Novell's NMS (Network Management System). The problem seems to be one of misdirected packets between the two management systems. Microcom also says it is working closely with Novell to fix the incompatibility.

Restrictions aren't limited to the LANlord server. The workstation on which you run LANlord Manager needs at least 8 MB of RAM. You can't run SHARE.EXE on a 286 DOS workstation and also run LANlord Manager on that workstation. Unfortunately, SHARE enables file sharing on a LAN, and many applications, such as Paradox for Windows, require that SHARE be loaded.

Agents, too, show a few quirks. The agent TSR program sometimes fails to respond to server requests when enhanced-mode Windows is running on top of the agent TSR and a DOS session is active. And the LANlord Windows Agent, which monitors Windows program activity, runs in standard or enhanced mode but not in real mode.

LANlord loads agent functions into memory from the disk as necessary to keep the size of the resident agent down to about 19 KB. Floppy drive-based computers will feel the slowdown as agent functions swap in and out of RAM. Finally, LANlord agents are compatible with the EMM-386.EXE memory manager that comes with DOS 5.0, but not with the version of EMM386.EXE shipped with Windows.

The LANlord Verdict

I found that LANlord did a good job of living up to its promise. The information it displays makes network configuration and control easy. Basically, LANlord keeps a network administrator from having to continually walk around the office fixing things, noting workstation hardware and software configurations, and watching who runs what software.

I recommend LANlord for medium and

BYTE ACTION SUMMARY

■ WHAT LANLORD 1.0 DOES

It monitors high-level NetWare LAN usage, keeping track of configuration and application program use of DOS and Windows clients.

■ LIKES

LANlord is a useful collection of networking tools and a good complement to low-level protocol monitoring tools.

■ DISLIKES

LANlord requires both OS/2 and Windows and has restrictive requirements on network software configuration. It lacks support for OS/2 and Mac clients.

■ RECOMMENDATIONS

LANlord is a good investment for configuration management if your network matches LANlord's requirements.

■ PRICE

One to 10 users, \$999
101 to 250 users, \$8999
(Other licenses available)

■ FOR MORE INFORMATION

Microcom
Client Server Technologies Group
1 Executive Blvd., Suite 4
Yonkers, NY 10701
(914) 968-2300
fax: (914) 968-7100

Circle 1227 on Inquiry Card.

Four reasons to buy a TI microLaser™ printer.



Now there's a way for you to put the power of Microsoft® Windows™ on paper — microLaser from Texas Instruments.

Designed to be Windows-compatible, there's a microLaser just right for your needs, whether you need a personal or shared printer. Here's why:

1. **Compatibility** With HP LaserJet® emulation and Adobe® PostScript® software, microLaser easily supports your demanding applications. And with our Microsoft Windows driver, set it and forget it with all Windows applications.

Not only does PostScript give you scalable outline fonts and graphics, it also means that your microLaser works in computing

environments like Windows, DOS®, Apple® Macintosh®, OS/2® and UNIX®.

2. **Performance** When it comes to printing high-quality documents fast, microLaser really makes you look good. At either nine or 16 pages-per-minute, microLaser printers speed you through documents in a hurry. Plus PostScript means what you see on your screen is what you get on paper. You can even turbocharge your microLaser with a RISC processor for blazing fast graphics.

3. **Reliability** When you buy a printer, you want it to print. And print. And print. That's just what the microLaser does.

Take our personal microLaser Plus for

example. With its high duty cycle of 10,000 pages-per-month* and a standard one-year limited warranty**, you can rely on your microLaser to work the first time, every time, for years.

4. **Value** Starting as low as \$999†, there's a microLaser designed to fit any budget. From the single user all the way up to a network. Consider this, too: microLaser's average cost per page is only 1.9 cents‡, while some laser printers average around 3.3 cents. The microLaser not only makes sense, it saves you money, too.

For details on the right microLaser for you and the name of the nearest dealer, call

1-800-527-3500.

The microLaser PS17 has earned the 1990 PC World Best Buy award; microLaser PS35 has earned the 1990 InfoWorld Excellent Value award and 4½ mice from MacUser, October 1990.

Features	microLaser Plus Basic	microLaser Plus PS17/PS35	microLaser Turbo	microLaser XL Turbo
PPM	9 ppm	9 ppm	9 ppm	16 ppm
Emulation	HP LaserJet II	HPLJII/PostScript	HPLJII/PostScript II	HPLJII/PostScript II
Processor	68000	68000	RISC/8220	RISC/8220
Fonts	14 HP Fonts	17 or 35 Scalable	35 Scalable	35 Scalable
List Price	\$999	\$1,399/\$1,499	\$1,749	\$3,649

TEXAS INSTRUMENTS

*Based on estimated typical usage. **For more information on service upgrade options, call 1-800-847-5757 in the U.S. and 1-800-268-6314 in Canada. †Suggested retail price — dealer prices may vary. ‡Based on suggested retail price of consumables and approximate page coverage rating for each consumable at 4% black (toner, developer and OPC). microLaser is a trademark of Texas Instruments Incorporated. Microsoft and DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. LaserJet is a registered trademark of Hewlett-Packard, Inc. Apple and Macintosh are registered trademarks of Apple Computer, Inc. OS/2 is a registered trademark of International Business Machines Corporation. UNIX is a registered trademark of AT&T. ©1992 TI 76543

DISCOVER 1992 INNOVATION AWARDS FINALIST

ALTER FOREVER YOUR SENSE OF SPACE AND TIME

Dance of the Planets is a rich and accurate animated model of the sky and solar system driven by true gravitational simulation. Never before has astronomy been so accessible. Go beyond the calculable to discover lost comets and errant asteroids, orbital resonance and chaos. With over 6,500 solar system objects and 10,500 stars and deep sky objects, the possibilities are open ended.

"most imaginative and imagination-inspiring software I have yet seen running on a PC..."

Richard Berry,
Astronomy Editor in Chief

DANCE OF THE PLANETS™

Order Today
1-800-SKY-1642

ARC Science Simulations
P.O. Box 1955B
Loveland, Colorado 80539

IBM compatible, 640 k, EGA/VGA,
HD, Math coprocessor recommended.
\$195 + s&h. Literature, demo available.
1-303-667-1168 FAX: 1-303-667-1105

LANLORD EVICTS LAN PROBLEMS

large LANs whose hardware and software configuration is already close to what LANlord needs to run. You can compare the cost of LANlord, at about \$100 per node, with the cost of a network administrator's time spent walking around the office; LANlord will pay for itself over the

**I'd like to see
LANlord expanded or
included in a more
complete network
management tool.**

course of a few months if you have an active administrator.

There are a few gaps, however: Since an OS/2 system is required for the server, I wondered why the developers decided to release the product with a Windows interface. For LANlord, a Presentation Manager interface would make more sense. Macintosh and OS/2 agents will be a welcome addition in a future version of LANlord. And I'd like to see LANlord incorporate a software-distribution facility to help manage the dissemination of new files and updates.

Most critically, LANlord is only a partial solution; I'd like to see it expanded or included in a more complete network management tool. If LANlord included lower-layer diagnostics as well as the top-layer features, I'd buy it in a heartbeat. As it is, I'm currently extending the functionality of our homegrown management solution to include a wider range of monitors—from Token Ring beacon detection to available server disk space—because my office needs soup-to-nuts tools. I could buy LANlord, Madge's Ring Manager, and maybe another product, but, considering all the licenses, the complete solution is just too expensive. ■

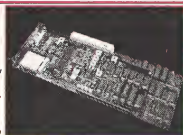
Barry Nance, a programmer for the past 20 years and a BYTE contributing editor, is the author of Using OS/2 2 (Que, 1992), Network Programming in C (Que, 1990), and Introduction to Networking (Que, 1992). He is the editor for the IBM Exchange on BIX, where you can reach him as "barryn."

Images in your Computer

from Video or full page Scanners. Double your productivity in
DeskTop Publishing, OCR and Multimedia applications.

ColorSnap PC

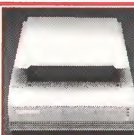
Professional, REAL TIME, video image capture in color (24-bit, 16.7 million colors) and gray scale. Capture from any NTSC/PAL video source, camcorder, live TV, still video etc. VGA, SVGA supported, files saved in standard formats. Superb image quality, Windows support.



\$599.00

Artiscan 24-bit true 600 or 800 dpi on both axes

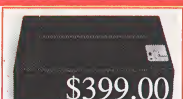
Professional, desk-top, fast (SCSI interface included), 24-bit color scanner. True 600 dpi on both axis. Superb picture quality in color and gray scale. Includes Image Processing software. Optional X-Ray, Transparency Scanner (\$699.00). OCR software options available. Recognita (add \$159.00). 800x800 dpi version \$1545. Best magazine ratings.



\$1199.00

PageReader 300

Full Page, 300 dpi Scanner complete with OCR WordScan software & line-art Imager software!! HP-ScanJet compatible driver hence compatible with any OCR package. Fast! Reads avg. page in <10 sec. Incredible introductory price \$399.00 complete!!! With Recognita, add \$159.00, with 9600 fax/modem send/rec, add \$99.00. Ideal in any office for text, autoCad drawings, presentations etc.



\$399.00

Color 3000

Full Page, color (24-bit) scanner (16.7 million colors or 256 gray scale). Complete with Color Image Processing Software. Fully HP ScanJet emulation driver.

Color 3000	\$599.00
WordScan	\$99.00
Recognita	\$159.00



\$599.00

Call or write for info on Scanner or
Video Based Image Transfer Systems

30-day return guarantee on all products. 1 year warranty. Major credit cards. Resellers Welcome.

Computer Friends, Inc. - 14250 NW Science Park Dr. - Portland OR 97229

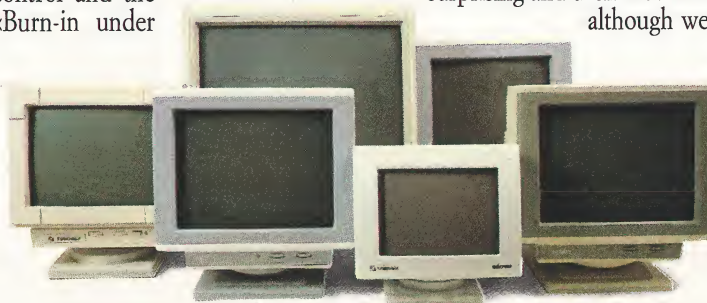
Toll Free 1-800-547-3303 - tel. (503)626-2291 - fax (503)643-5379



SOMEONE WILL BE PRICE DIS-ORIENTED

It's inevitable. Faced with the superior quality and moderate prices of our monitors, someone will be disoriented. And to obtain the same results, they are going to discover that many things are necessary - high specialization and large scale productivity, assembly line automation, fully independent ability to construct each individual component. But industrial efficiency is not enough. Production must undergo severe quality control and the toughest of all tests: «Burn-in under extreme conditions», to which all of our monitors are constantly subjected.

All this in full respect for European community regulations on standards for safety and electromagnetic emissions. Lastly, they will have to take into account Italian design and a complete range of monitors offering models of long-term stability. And a sales organization which is always ready to fulfil any request, as regards both delivery of products and technical assistance. So our competitors' dismay is not surprising and their disorientation is fully justified, although we ourselves are sure of achieving even better results in the future.



HANTAREX

A LEADING INDUSTRY IN MONITOR TECHNOLOGY

Headquarter: Via Perfetti Ricasoli, 78 - 50127 Firenze - Italy - Fax 39 55/4220129

UNITED KINGDOM

London
Tel. 44-81-778-1414
Fax 44-81-659-9348

GERMANY

Altenkirchen
Tel. 49-2681-3041/2
Fax 49-2681-7222

SPAIN

Barcelona
Tel. 34-3-3232941
Fax 34-3-4538163

GREECE

Athens
Tel. 30-1-9910950
Fax 30-1-9932801

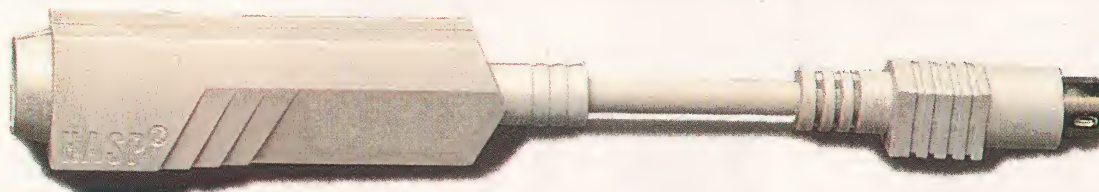
HUNGARY

Budapest
Tel. 36-1-1832366
Fax 36-1-1145965

SOVIET UNION

Moscow
Tel. 95-3342974
Tlx 412160 ANTAR-SU

MacHASP[®] The Professional Software Protection for the Macintosh



SEE US AT
COMDEX/Fall '92
Booth #S 886



MacHASP is the most advanced hardware based software protection system for Macintosh computers.

Each MacHASP key contains a unique code, recognized by the protected software. During runtime, the protected program checks whether a MacHASP key with the appropriate code is connected to the computer. If the key's code is confirmed, the software can be executed. If not, the software will not run.

The HASP system is based on advanced ASIC (Application Specific Integrated Circuit) components and sophisticated encryption algorithms. State-of-the-art engineering ensures full protection of your software with no hassles for your clients.

THESE ARE SOME OF MacHASP'S OUTSTANDING FEATURES:

- MacHASP keys are totally transparent to the operation of the computer and any peripheral equipment.
- The user can create backup copies freely and can run your software directly from a hard-disk or a backup diskette (the original diskette is not required).
- The protection system is easy to incorporate in your software. All necessary software, examples and documentation are provided.
- MacHASP keys contain a memory which can be read and written on any computer.



IT IS POSSIBLE TO PROTECT PROGRAMS WITHOUT THE SOURCE CODE

For further information, please see our full-page ad in this issue for the nearest HASP distributor.



ALADDIN
KNOWLEDGE
SYSTEMS LTD.

15 Beit Oved St., Tel-Aviv, Israel
P.O.Box: 11141 Tel-Aviv 61110,
Tel: 972-3-5375795
Fax: 972-3-5375796

© 1992 Aladdin Knowledge Systems Ltd.

FacetTerm

UNIX Windowing For Character Terminals & PCs

You can increase productivity by giving users simultaneous access to multiple UNIX applications on a character terminal or PC.

FacetTerm Features:

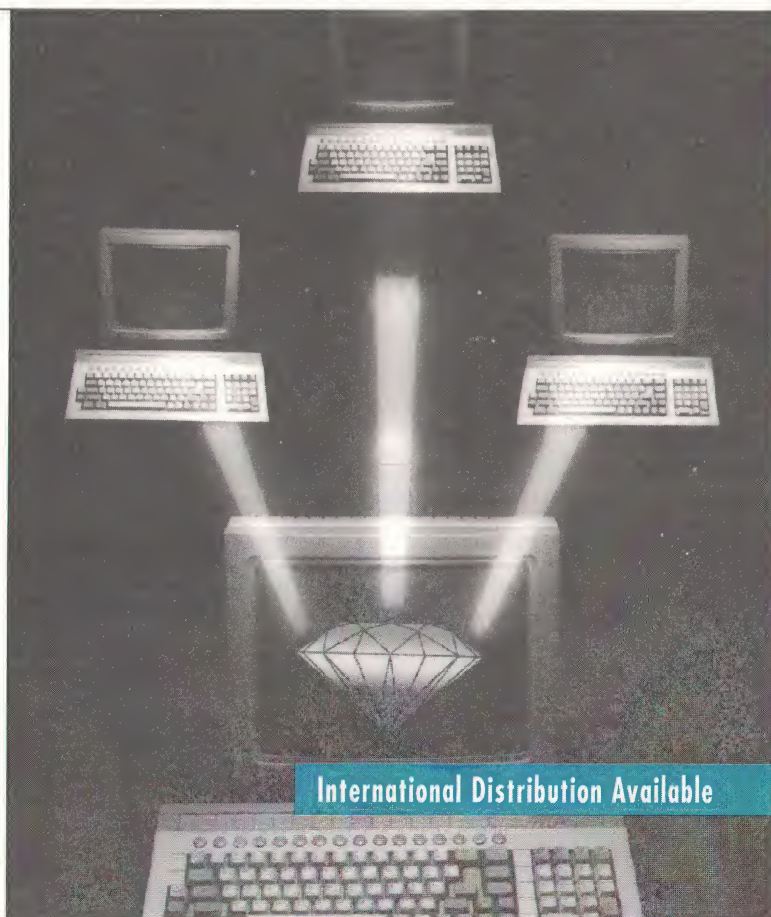
- Multiple, concurrent UNIX sessions for each user.
- Hot key between word processing, DBMS, spreadsheet, 3270 emulation, and any other UNIX application.
- Screen print.
- Cut & paste between applications.
- Pull down menu interface.

Free Evaluation Program!
Full features, documentation and support for 30 days.



**Structured Software
Solutions, Inc.**

4031 W. Plano Parkway • Suite 205
Plano, Texas 75093
214 / 985-9901 • Fax 214 / 612-2035



International Distribution Available

PROGRAMMING TOOLS

Ada	Algol
Assemblers	Awk
Basic	C
C++	Cobol
Comal	Comms
Cross Dev	Database
Debuggers	Editors
Forth	Fortran
Graphics	Icon
Linkers/Locaters	Lisp
Logo	Modula-2
Pascal	Prolog
Rexx	Smalltalk
Snobol4	Version Control
Windows	Yacc & Lex

We stock many items for which there is no space in these advertisements.

GREY MATTER

Prigg Meadow, Ashburton, Devon TQ13 7DF

Prices do not include VAT or other local taxes, but do include delivery in the UK and Europe. Please check prices at time of order as ads are prepared some weeks before publication. This page lists some of our products - call us for a complete price list and details of discount structure.

ORDER BY PHONE WITH YOUR CREDIT CARD

TEL: (0364) 53499

FAX: (0364) 53071

C & C++ LIBRARIES

Comms			Screen		
C Asynch Manager	DOS	£115	C Windows Toolkit	DOS	£59
C Comms Toolkit	DOS	£89	C-Shape + Look&Feel	OS2&DOS	£370
COMM-DRV	DOS	£59	Greenleaf Datawindows 3.0	DOS	£180
Essential Comms	DOS	£170	MEWEL Window System	DOS	£175
Greenleaf CommLib 3.2	DOS	£175	Object Professional for C++	DOS	£140
Silvercomm C Asynch	DOS	£125	Panel Plus II	OS/2&Win&DOS	£260
Database			ProtoGen 2.1	Win	£55
Btrieve	Win,DOS	£310	ProtoView	Win	£299
C-tree Plus	DOS	£310	TCXL-DOS 6.0	DOS	£69
CodeBase 4.5	DOS	£195	Turbo Vision	DOS	£25
D-ISAM	DOS	£275	Turbo Vision Dev Toolkit 2.0	DOS	£85
D-ISAM Transaction Module	DOS	£155	Vermont Views 3.0	DOS	£299
Faircom Toolbox Prof	DOS	£645	Zinc 3.0	DOS	£125
Natural Query Integrator's Kit	DOS	£115	General & Systems Libraries		
POET	DOS	£225	C Tools Plus/6.0	DOS	£90
Pro-C v2.1	DOS	£99	CodeRunner	DOS	£130
Pro-C v2.5	DOS	£485	Heap Expander 3.0	DOS	£110
Raima Data Manager	Win,DOS	£265	Hold Everything	DOS	£110
SoftFocus Btree/ISAM	DOS	£70	PDK #1, #2, #3	DOS	£75
Sycoro.C Network	DOS	£895	PowerSTOR	DOS	£85
Watcom SQL Developer	DOS	£240	Resident-C	DOS	£130
Graphics			TesSeRact TSR Dev Sys 2.0	DOS	£69
Essential Graphics Chart	DOS	£105	Tools.h++ w/Source	DOS	£190
Essential Graphics Kernel	DOS	£110	TSRs and More	DOS	£95
Essential Graphics GUI	DOS	£79	Math & Scientific		
GraphiC 6.0	DOS	£250	C/Math Toolchest & Grafix	DOS	£45
graphics-MENU & Data Entry	DOS	£155	Huge Virtual Array & NAT	DOS	£145
GSS GDT	DOS	£410	Linpack.h++ w/Source	DOS	£320
GX Graphics 2.0	DOS	£135	Math.h++ w/Source	DOS	£190
HALO Professional 2.0	DOS	£210	Matrix.h++ w/Source	DOS	£255
MetaWINDOW 4/32	DOS	£230	Mathpak 87	DOS	£85
object-Menu	DOS	£255	Science & Eng Tools 8.0	DOS	£79
PCX Toolkit 5.0	DOS	£135	LOW PRICES FOR MICROSOFT & BORLAND PRODUCTS		
Real-Time Graphics & M/CT	DOS	£125	Microsoft C/C++ 7.0	£222	
TEGL Windows Toolkit II 2.2	DOS	£65	Microsoft C/C++ Upgrade	£99	
Tools			Microsoft Cobol 4.5	£435	
C-Clearly	DOS	£99	Microsoft Fortran 5.1	£205	
C-Vision	DOS	£80	Microsoft Macro Assembler 6.0	£75	
Clear+ for C	DOS	£135	Microsoft Prof Toolkit for VB	£135	
CodeCheck Prof	DOS	£435	Microsoft QuickC 2.5	£50	
MKS LEX & YACC	OS2&DOS	£165	Microsoft QuickC & Assembler	£83	
PC-Lint	OS2&DOS	£75	Microsoft QuickC for Windows	£95	
PCYACC Prof	DOS	£435	Microsoft Source Profiler	£45	
DEBUGGERS			Microsoft Test for Windows	£185	
Bounds Checker	386	£155	MS Visual Basic for Windows	£95	
Multiscope for DOS	DOS	£160	MS Visual Basic for DOS	£95	
Multiscope for Windows	Win&DOS	£310	MS Visual Basic for DOS Prof	£222	
Periscope I/512K	DOS	£450	Microsoft Windows 3.1	£70	
Periscope II	DOS	£135	MS Windows SDK 3.1	£165	
Periscope II-X	DOS	£120	Borland C++ 3.1	£199	
Periscope/EM	386	£160	Borland C++ & AFX 3.1	£295	
Periscope/32 for Windows	Win	£235	dBase IV 1.5	£335	
Quaid Analyser	DOS	£130	ProtoGen for Borland C++ 2.0	£39	
Soft-ICE	386	£285	Turbo C++ 3.0	£50	
Soft-ICE/W	Win-386	£310	Turbo C++ & Turbo Vision 3.0	£70	
Soft-ICE & Bounds Checker	386	£390	Turbo C++ for Windows 3.1	£85	
EDITORS			Turbo Debugger & Tools	£89	
Borland Brief 3.1	DOS	CALL	Turbo Pascal 6.0	£69	
EC Editor	DOS	£40	Turbo Pascal Professional 6.0	£135	
ED for Windows	Win	£199	Turbo Pascal for Windows 1.5	£85	
Epsilon v5	DOS	£190	Turbo Vision 1.1	£25	
Kedit v5	DOS	£110	Paradox 4.0	£335	
Multi-Edit Lite	DOS	£50	Paradox Engine 2.0	£89	
Multi-Edit Standard v6	DOS	£85	WITH FULL TECHNICAL SUPPORT		
Multi-Edit Professional v6	DOS	£140	SMALLTALK		
Norton Editor v2	DOS	£45	Smalltalk/V DOS 3.0	DOS	£79
PVCS Prof Editor	DOS	£180	Smalltalk/V 286	286	£120
QEdit Advanced	DOS	£40	Smalltalk/V PM	OS2	£280
Vedit-Plus v3.5	DOS	£120	Smalltalk/V Windows 2.0	Win	£275

DEBUGGERS

Bounds Checker	386	£155
Multiscope for DOS	DOS	£160
Multiscope for Windows	Win&DOS	£310
Periscope I/512K	DOS	£450
Periscope II	DOS	£135
Periscope II-X	DOS	£120
Periscope/EM	386	£160
Periscope/32 for Windows	Win	£235
Quaid Analyser	DOS	£130
Soft-ICE	386	£285
Soft-ICE/W	Win-386	£310
Soft-ICE & Bounds Checker	386	£390

EDITORS

Borland Brief 3.1	DOS	CALL
EC Editor	DOS	£40
ED for Windows	Win	£199
Epsilon v5	DOS	£190
Kedit v5	DOS	£110
Multi-Edit Lite	DOS	£50
Multi-Edit Standard v6	DOS	£85
Multi-Edit Professional v6	DOS	£140
Norton Editor v2	DOS	£45
PVCS Prof Editor	DOS	£180
QEdit Advanced	DOS	£40
Vedit-Plus v3.5	DOS	£120

For more information please call us.

C & C++ COMPILERS

NEW HIGH C/C++ 386 3.02 includes templates, global optimiser, Borland C++ compatibility options, supports Phar Lap, Ergo & Rational Extenders. **ONLY £475.**

Aztec C86-c	DOS	£265
Borland C++ 3.1	Win&DOS	£199
Borland C++ & AFX 3.1	Win&DOS	£295
Microsoft C/C++ 7.0	Win&DOS	£222
Microsoft C/C++ Upgrade	Win&DOS	£99
MS QuickC 2.5	DOS	£50
MS QuickC & QuickAsm	DOS	£83
MS QuickC for Windows	Win	£95
Topspeed C Prof	Win&DOS	£165
Topspeed C++ Prof	Win&DOS	£165
Turbo C++ 3.0	DOS	£50
Turbo C++ for Windows 3.1	Win	£85
Watcom C 9.0	OS2&Win&DOS	£275
Zortech C++ 3.0	Win&DOS	£370
High C/C++ 386 3.02	PL386	£475
Intel 386 C Code Builder	Win&386	£370
NDP 386 C	386	£545
Watcom C/386 9.0	Win&386	£485

ADA COMPILERS

IntegrAda	DOS	£199
IntegrAda/386	386->DOS	£375
Janus/Ada Compiler	DOS	£69
Janus/Ada PDS	386->DOS	£340
OpenAda DOS	DOS	£260
OpenAda DOS 286	286	£495
OpenAda DOS 386	386	£695

DISK COPYING SERVICE

We can copy files to and from 600 disk formats including CP/M, CP/M-86, MS-DOS, PC-DOS, APPLE, SIRIUS, BBC, TORCH, APRICOT, HP-150, TRSDOS, AMSTRAD, ATARIST, MACHINTOSH. Our charge is £10.00 + disk + VAT with discounts on small quantities and disks are normally despatched within 24hrs of receipt. For more information call us.

TURBO PASCAL LIBRARIES

Asynch Plus	DOS	£115
Asynch Professional	DOS	£75
B-Tree Filer Network	Win&DOS	£99
graphics-MENU & Data Entry	DOS	£155
Huge Virtual Array & NAT	DOS	£145
Mathpak 87	DOS	£85
Object Professional	DOS	£110
Power Tools Plus/5.1	DOS	£95
Real-Time Graphics & M/CT	DOS	£125
Science & Eng. Tools 8.0	DOS	£79
TEGL Windows Toolkit II 2.2	DOS	£65
TesSeRact TSR Dev Sys 2.0	DOS	£69
Topaz Single-User	DOS	£79
Turbo Analyst	DOS	£69
Turbo Professional	DOS	£79
Turbo Vision Dev Toolkit 2.0	DOS	£85
TurboWINDOW 4/32	DOS	£115

BASIC COMPILERS & INTERPS

NEW VISUAL BASIC for DOS provides an event-oriented programming model with rich user-interface tools and is upwards compatible with QuickBasic & Basic 7.1. **ONLY £95.**

PROFESSIONAL EDITION adds an optimising compiler, database ISAM, charting & presentation graphics toolkit, custom control development kit & MOVE overlays (as in C++ 7.0). **ONLY £222.**

UPGRADES from QuickBasic & Basic 7.1 are also available - call us for details.

GFA-BASIC	DOS	£85
GFA-BASIC for Windows	Win	£170
MS Visual Basic	Win	£95
MS Visual Basic for DOS	DOS	£95
MS Visual Basic for DOS Prof	DOS	£222
PowerBASIC	DOS	£110

CROSS ASSEMBLERS

We supply C Cross Compilers by 2500AD, Avocet, Aztec, Lattice, IAR and Hi-Tech hosted on DOS and targeted on Z80/64180, 6502, 6801, 68HC11, 6301, 6809, 7811, 8051, 8096 & 68000/020. Also cross-assemblers by Avocet, 2500AD, Crash Barrier (METAi) and IAR Systems hosted on DOS, CP/M-86 and CP/M-80 with over 30 target processors. In total over 200 products with no space to list them here. We hold some stock but you should allow 10-14 days for delivery. Please call for information or advice.

Lemon computers: un marchio ormai da anni protagonista nello scenario informatico.

In un mercato sempre più complesso e competitivo Lemon vi offre la garanzia della sua decennale esperienza.

ONE RIGHT CONNECTION...

La gamma dei nostri prodotti è in grado di soddisfare qualsiasi esigenza applicativa, sia dal processore 80286 fino al veloce 486 con bus EISA. Tutti i modelli hanno un alto grado di affidabilità, grazie anche all'elevato standard qualitativo dei materiali utilizzati.

Qualità di prodotto e qualità globale, che significa un "team" di specialisti costantemente al vostro fianco per fornirvi consigli, assistenza tecnica e soluzioni più opportune.

Lemon computers, the right solution!



One & One

D-LINK: una sigla nel mondo del net-working informatico. Un mondo infinito di possibilità si apre di fronte a voi senza dover fare cospicui investimenti.

ONE BRIGHT CONNECTION

Con JEN e D-LINK non ci sono problemi. Si possono collegare in rete uno o più computers, incrementare la potenza, aggiungere un nuovo computer tutto questo senza difficoltà di installazione. Si possono scegliere tra i vari sistemi operativi LANSMART - NOVELL - UNIX, si aggiungono le schede ed è fatta! Tutto questo dà la possibilità di modulare i propri investimenti in sintonia con le proprie esigenze.

D-LINK the bright solution!



JEN ELETTRONICA srl

Zona Ind. E. Fermi - 62010 MONTELUPONE (MC) - Tel. 0733/224012 - Fax 0733/224035
MILANO - Tel. 02/2138676 - Fax 02/2138831 - Italia

268IS-4 BYTE • NOVEMBER 1992

LEMON
computers

D-Link

Circle 422 on Inquiry Card.

HARDWARE

Network Modems Dial in, Dial out, and Route Packets

STEVE APIKI, TOM THOMPSON, AND JON UDELL

A modem is a modem, but a shared network modem is more like three devices in one: It can act as a connection point for remote users who need LAN access, a shareable resource for LAN clients that need to reach dial-up services, or a LAN-to-LAN router.

In merging these three functions, the network modem combines many capabilities of communications servers and routers into a single, easily configured box. Naturally, a network modem won't replace a dedicated router or communication server; what you gain in ease of setup and configurability you'll pay for in power and scalability. But for many smaller businesses, or workgroups within large organizations, a network modem provides an attractive, all-around solution to dial-up communications requirements.

In this review, we'll look at two LAN-based modems, the Microtest Lanmodem

and the Shiva NetModem/E (see photos 1 and 2). Both are high-speed V.32bis modems that connect directly to Ethernet networks. Both will carry out all the tasks listed above, but the NetModem/E runs both AppleTalk and NetWare protocols, while the Lanmodem works exclusively on NetWare LANs.

On the Wire

Network modems sit directly on the wire, communicating with clients via LAN protocols. Both of the devices we tested are designed for Ethernet connections, but Microtest and Shiva offer versions for other physical topologies, including Token Ring and LocalTalk.

The Lanmodem is a dedicated NetWare device—it communicates via SPX/IPX, requires a NetWare server to maintain its boot files, and routes NetWare packets. The more versatile NetModem/E runs on

both NetWare and AppleTalk LANs and in mixed-network installations.

Both the Lanmodem and NetModem/E are V.32bis modems, handling communication rates of up to 14.4 Kbps. Both support V.42 error correction and V.42bis data compression, which can yield speed gains of up to

4 to 1 when communicating with other V.42bis modems. The Lanmodem also includes a serial port to which you can connect a second modem for sharing on the network.

These products provide dial-out and dial-in capability through client software bundled with each product. Dial-out client software takes three forms, depending on environment. Under DOS, it consists of an INT14 or other standard communications protocol redirector. Windows clients get a new communications driver that replaces COMM.DRV. Finally, Macintosh clients get a communications driver that can be activated through the Chooser. Dial-in software is similarly dependent on environment, but in every case each remote client requires some software in order to connect to the host LAN.

In addition to the dial-in and dial-out utilities, the Lanmodem and NetModem/E also provide software for administering configuration and security. Typically, these utilities let administrators assign access permissions and configure the modems for LAN-to-LAN connection. One nice feature that both modems support is dial-back, which provides an extra level of security and the convenience of billing your office directly for the connect charges you accrue while working at home.

Microtest Lanmodem

Lanmodem's Novell-only orientation restricts the networks on which it can be installed, but it makes setup, administration, and use conceptually simple. However,

the eccentricities of the user interface common to all the Lanmodem's utilities can cause a little frustration.

Once the Lanmodem is running, the network administrator sets up communication parameters and user-access privileges. You can set configurations for both

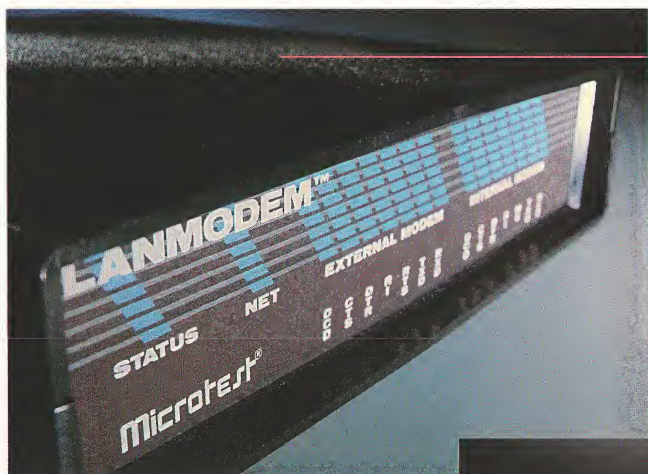


Photo 1: The Lanmodem displays a full set of status lights for both internal and external modems if you've connected an external unit to its serial port. On the back, the Lanmodem has ports for thin-wire, AUI, and 10Base-T Ethernet.

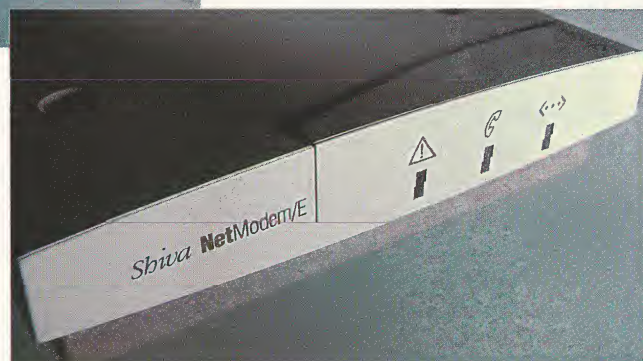


Photo 2: Shiva's NetModem/E supports AppleTalk and NetWare LANs and has modules for connecting to different types of Ethernet networks.

A MESSAGE TO OUR SUBSCRIBERS

FROM TIME TO TIME WE make the BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE Magazine
Attn: Subscriber Service
P.O. Box 555
Hightstown, NJ 08520



NETWORK MODEMS

internal and external modems, if an external modem is connected to the serial port. External and internal modems are completely independent, so you can make one available for dial-in and the other available for dial-out, if you wish. You set user-access parameters (e.g., dial-in, dial-out, and dial-back) by checking a box for each NetWare user or NetWare group. Because Lanmodem reads the NetWare bindery directly, you don't have to key in any user names or maintain another group of users—a handy administrative feature.

All the tools for Lanmodem, both administrative and user, run under a GUI created using Zinc Software's interface library. Microtest's GUI was a little hard to

work with, because it doesn't quite follow familiar Windows and Mac conventions.

Dialing out with the Lanmodem provided stable, reliable connections, and at 9600 bps it was hard to tell we were using a redirected modem at all. As with all network communications devices, you need to load a DOS redirector in order to access the Lanmodem. You also need a communications program (e.g., the networked version of Procomm Plus) that supports INT14 or NASI (Novell Asynchronous Services Interface) redirectors. Dial-out communications seemed a little hard to use at first, as the documentation didn't make it clear that you could load the redirector without running the graphical shell. However, Microtest's knowledgeable technical-support staff set us straight, and we were able to include loading and unloading the redirector in a batch file that launched Procomm Plus.

On the other hand, dial-in access to NetWare could hardly be easier. Microtest provides a dial-in package called FastLink that includes a full remote IPX stack. When you launch FastLink, it dials up the host you specify in a configuration file. Once the modems negotiate a connection, FastLink loads a packet driver, IPX, and NETX (a total of 69 KB), leaving you at a DOS prompt attached to a remote server—just as if you had loaded a local shell. Note that the packet driver you get with Lanmodem is not generic; you can't run other protocols (e.g., TCP/IP—we tried) through FastLink's packet driver. The only connection problems we had during dial-in were when using the dial-back feature, and those we solved by tweaking remote modem parameters.

When connecting with 2400-bps modems, we found dial-in access was just too slow to be practical. However, connections of 9600 bps and up were perfectly reasonable and gave a pretty good illusion of local access. That illusion dissolves the instant you try to run a remote program, which requires loading the entire executable file into memory across the wire. FastLink traps remote execution attempts and asks you whether you want to continue or whether FastLink should instead download the file to a local disk for faster future access. FastLink also handles unexpected disconnects, attempting to redial lost connections.

With dial-in, you cannot be a client on both the remote LAN and the local LAN simultaneously. For that kind of access, you need to configure Lanmodem as a router. In its routing mode, Lanmodem routes IPX packets from the local LAN to another Lanmodem or Novell Asynchronous Router on a second network.

continued

BYTE ACTION SUMMARY

■ WHAT NETWORK MODEMS DO

They provide a dial-in LAN connection for remote users, a shared dial-out resource for LAN clients, and an asynchronous LAN-to-LAN connection.

■ LIKES

Mixed network support of NetModem/E; tight NetWare integration and additional serial port on Lanmodem.

■ DISLIKES

Lanmodem's user interface; some difficulty making high-speed connections with both products.

■ RECOMMENDATIONS

For mixed-LAN and AppleTalk support, the NetModem/E is your only choice; NetWare-only shops should choose the Lanmodem.

■ PRICE

Microtest Lanmodem, \$1995
Shiva NetModem/E, \$1699

■ FOR MORE INFORMATION

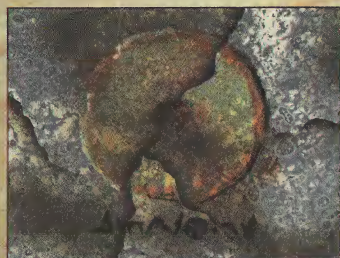
Microtest, Inc.
4747 North 22nd St.
Phoenix, AZ 85016
(800) 526-9675
(602) 957-6400
fax: (602) 971-6963
Circle 1229 on Inquiry Card.

Shiva Corp.
1 Cambridge Center
Cambridge, MA 02142
(800) 458-3550
(617) 252-6300
fax: (617) 252-4852
Circle 1230 on Inquiry Card.

The Evolution of CAD

From the beginning of time, we have tried to express ourselves through graphics.

From the beginning of time, people had to use primitive design tools for creating any type of graphics.



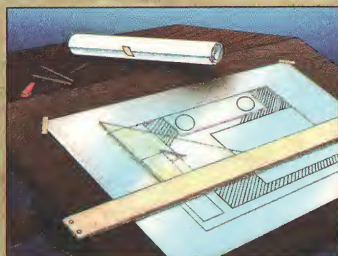
In the 15th Century design tools were quill ink pens and crude styles of paper.



300 to 400% less \$ than AutoCAD!

Faster and easier to use than AutoCAD!

By the 18th Century we had advanced to the draft-table with T-squares, and the dreaded eraser.



In the 20th Century the first CAD programs were very slow and extremely difficult to use, not to mention the expense of buying them.

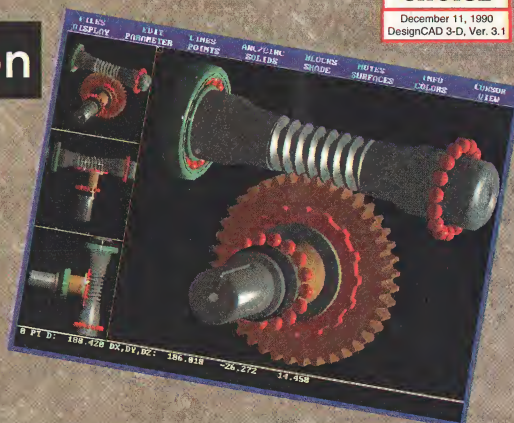
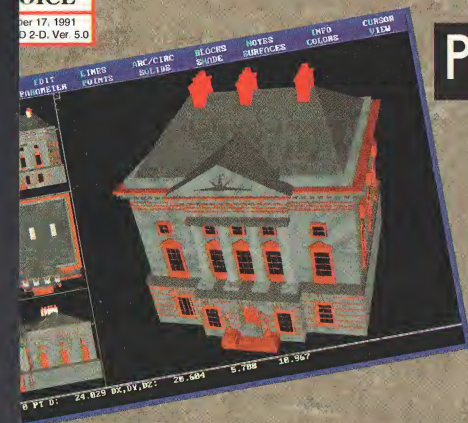


Now step into the 21st Century...

DesignCAD

NEW

Professional Version



DesignCAD Professional is the only complete CAD solution. It's 6 packages in one!

- **DesignCAD 2D** has all the tools and power necessary to produce professional architectural or mechanical blueprints. With DesignCAD 2D you will become extremely productive!
- **DesignCAD 3D** gives you the power to create and manipulate solid or wireframe objects with quick and easy commands. Render your designs with outstanding photorealistic color!
- **Video Training Tapes** for DesignCAD Professional, are produced in a state-of-the-art facility using award winning writers, and professional technicians. Using these video tapes will assure you of learning faster with higher retention, while becoming more productive!
- **SmartEST** quickly generates a spread sheet from your DesignCAD drawings so you may estimate cost, and do take-offs for accurate bidding.
- **Symbol Libraries** contain over 6700 pre-drawn Architectural and industry standard symbols. These alone will save you a tremendous amount of time and money!
- **ScanPRO** converts (Raster to Vector), scanned images into files that can be read by DesignCAD or most other CAD programs.
Circle 86 on Inquiry Card.
Call, fax or write for a **FREE** brochure & demo!



American
Small Business Computers

One American Way
Prvior, OK 74361

ph: (918) 825-4844 fax: (918) 825-6359

Every client on one LAN then has access to resources on the other, given sufficient NetWare access rights. We tested out the Lanmodem routing between our LAN and Microtest's demonstration network, which ran a second Lanmodem router. The connection was very quick, robust, and easy to set up.

Shiva NetModem/E

The NetModem/E offers connection services to both AppleTalk and NetWare LANs. Mac users can run NetModem/E software on System 6.x and System 7.0 Macs. As with the Lanmodem, you can use the NetModem/E for 14.4-Kbps dial-out, dial-in, or routing.

For Mac dial-out, you use the Shiva Config Control Panel to select what serial port (either modem or printer) gets redirected via the AppleTalk driver to the NetModem/E. You also set time-out intervals here; if no I/O activity takes place on the redirected port for a certain amount of time, the software automatically disconnects the modem. This is handy for occasions when you might leave the Mac unattended during a lengthy download, yet you want the long-distance connection broken

after the transfer completes.

You select the NetModem/E from the Chooser, as you would with printers or file servers. One nice interface feature: If the selected NetModem/E is being used by another user—whether it's a Mac or a Windows PC—you get an alert that tells you who's tying it up. You can opt to cancel the connection attempt or try to connect later. In the latter case, you'll get another alert when the NetModem/E becomes available.

You can dial out from a NetWare LAN using either a DOS INT14 redirector or a Windows COMM.DRV replacement. Shiva provides a Mac-like "Chooser" for Windows and DOS that scans for NetModem/E units and pools and attaches them to COM ports. As in the Mac version, a simulated modem display appears on-screen when you launch a communications program. Under DOS we ran the INT14 version of Procomm, and under Windows we used Terminal and Dynacomm. The modem display, naturally, is much nicer in Windows than in DOS. Yet Shiva's trademark digitized modem sounds work only in DOS—oddly, there's no sound support for Windows.

The NetModem/E administrator can establish a list of authorized users but must manually synchronize that list with NetWare and AppleShare servers. We used the NetModem/E to call a variety of services from both DOS and Windows at speeds up to its peak 14.4 Kbps.

Dial-in also supports remote Mac and PC clients. From a Mac, you make a remote connection by double-clicking on an icon in the Network Control Panel. You can also set up dial-in names, phone numbers, and baud rates. Once connected, you appear as a node on the remote network. PowerBook users will recognize this as the same capability provided by Apple's AppleTalk Remote Access software. While ARA comes bundled with PowerBooks, it isn't provided with desktop Macs, so Shiva's Dial-In Access software will be handy for those connecting from home desktop Macs to the office network.

We tested Dial-In Access from a PowerBook 170 using a Global Village PowerPort/Gold 14.4-Kbps modem. We were able to make reliable connections only at 9600 bps. Dial-In Access doesn't use Apple's CCL (Command Connection Language) files. CCL files let you select a

GREAT THINGS COME IN SMALL PACKAGES

This powerful print server can tackle your biggest network printing problems

- Connects any parallel printer directly to your Ethernet LAN
- Fully Novell Network 286 and 386 compatible
- Can attach to 8 file servers simultaneously
- Fast and easy to install
- Combines high-speed printing and exceptional printer control
- Supports encrypted passwords, forms, notify, cancel, and others
- Full one-year warranty and unlimited free technical support
- Made in the U.S.A.



Make the Rose Connection

ROSE
ELECTRONICS

10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713) 933-7673 • Fax (713) 933-0044

1-800-333-9343

INTRODUCING THE LANSTOR® DISK ARRAY.

NONSTOP STORAGE FOR NONSTOP NETWORKS.



Today's Novell® networks operate around the globe and around the clock. These networks require much more than just protection against data loss. They demand

uninterrupted network operation. Storage Dimensions answers that demand with the new LANStor Disk Array, delivering nonstop storage for today's nonstop networks.

With its unique architecture and fully-redundant power supply modules, the LANStor Disk Array pushes fault-tolerance to a new level. Hard disk and power modules can be instantly "hot-swapped." Data is reconstructed on-line, on-the-fly. There's no system downtime. There's no data loss.

The LANStor Disk Array is also built for speed. Its independent processor frees the server CPU from time-consuming array management. State-of-the-art Fast SCSI-2 drives and adapters speed data throughput. Add our award winning LANStor drivers and you get array performance that's second to none.

The LANStor Disk Array, in 2.1 to 4.2 GB models, supports RAID 5 and adapts in minutes for rack mount, tower or desktop installations. Larger systems can be configured to deliver more than 100 GB of nonstop storage. For more information and a copy of our white paper, "Fault-Tolerant Storage for Nonstop Networks," call 800-765-7895 or write Storage Dimensions, 1656 McCarthy Boulevard, Milpitas, CA 95035.



STORAGE DIMENSIONS

Circle 195 on Inquiry Card.



modem by name instead of dealing with AT commands and S-register settings. Shiva's LanRover/L uses CCL files, but Dial-In Access users must use a Shiva application to configure new modems; we had to do this for the PowerPort/Gold.

For dial-in access to NetWare LANs, Shiva provides an ODI (Open Data-link Interface) driver that sends Ethernet packets from your remote PC through a phone line to a NetModem/E sitting on the LAN. You build connection scripts interactively or by editing the sample Shiva provides. Once connected, you load the NetWare shell (IPX and NETX) and log in. You can just call the NetModem/E or arrange to have it turn around and call you back.

You can, and should, also load the optional LaunchGuard TSR program. Like Microtest's FastLink, LaunchGuard keeps you from accidentally running remote programs. The idea, of course, is to maintain copies of all your programs on the remote PC and use the asynchronous connection to link those programs to LAN-resident data and services. This setup is perfect for client/server applications like Shiva's own ShivaNet Manager.

However, even with LaunchGuard you

can find yourself in an unintentional file transfer. When we fired up the Epsilon text editor from the C drive, for instance, it began loading the first copy of its 70-KB configuration file that it found on the path—which happened to be on the remote network. Fortunately, Shiva provides an escape mechanism—Ctrl-Alt-E—so you don't have to wait out the transfer or reboot.

Dial-in and dial-out are nifty features, but network-to-network routing is simply stunning. Using ShivaNet Manager, we told the NetModem/E on BYTE's LAN to call its counterpart on Shiva's technical-support LAN. Once IPX routing was under way, we could fire up File Manager and literally drag files between Cambridge, Massachusetts, and Peterborough, New Hampshire. With matched NetModem/E's in the circuit, transfers were really fast. After breaking down the connection, we repeated the same experiment from a Mac. The NetModem/E obligingly set up AppleTalk routing between the two LANs. It worked so seamlessly that we dialed out to MCI using another NetModem/E attached to the remote LAN. (Don't worry, Shiva, we used MCI's 800 number.)

Excellent Choices

Network modems are excellent choices for smaller networks that don't require a full-fledged router or communications server. The most significant problems we had with both the Lanmodem and NetModem/E were in configuring remote modems for consistently negotiating high-speed connections.

Selecting between the two will depend mainly on your network. The Lanmodem is more expensive than the NetModem, but it offers a second port for easy expansion. If you run AppleTalk or a mixed environment, the NetModem/E is your only option. For NetWare-only LANs, the NetModem/E is also a good choice, but we found that the Lanmodem's tight integration with NetWare made it easier to work with, despite its quirky interface. ■

Steve Apiki is a BYTE technical editor, and Tom Thompson and Jon Udell are BYTE senior technical editors at large. You can contact them on BIX as "apiki," "tom_thompson," and "judell," or on the Internet at apiki@bytepb.byte.com, tomt@bytepb.byte.com, and judell@bytepb.byte.com, respectively.

Discover The X Terminal Inside Your PC!

X-One software transforms your PC into an X terminal.

Access network-based UNIX and VMS applications while using your favorite DOS or MS-Windows programs.

Whether you prefer Windows or DOS, X-One comes with both versions in a single package.

Other cost-saving features include built-in TCP/IP network software—making X-One an even greater value.

X-One is easy to install and use, and is compatible with leading network packages.

Purchase X-One software and connect to the world of X Windows!



GRAFPOINT™
The X Connection®

1485 Saratoga Avenue
San Jose, CA 95129
408/446-1919
408/446-0666 Fax

Call For Demo & Details: 800/426-2230

X-One and The X Connection are trademarks of Grafpoint, Inc.
All other trademarks or tradenames are the property of their respective holders.

AVER MULTIMEDIA



AVer 1000-V (NTSC or PAL)

- VGA to TV Card, w/Broadcasting video Quality
- VGA Chip (ET-4000) on board
- Flicker-Free Filter on board
- Two Types: 256 colors or 32K Colors
- 800x600 Video Resolution
- Provides Video output for AVer 2000

AVer 2000 (NTSC or PAL)

- PC-based Frame Grabber
- Displays Scalable LIVE Video Window on VGA monitor under WINDOWS or DOS
- Supports TIFF, PCX, BMP, TGA, YUV... file formats.
- Option kit: S-Video input kit, TEMPRA S/W



We also have following items:

- VGA to TV OVERLAY/GENLOCK Card
- VGA to NTSC Card
- JPEG Compression Card
- TUNER Card
- TARGA 16 Compatible Card
- FLICKER-FREE POCKETVIDEO

COMDEX/Fall '92 Bally

MANUFACTURED BY:

ADDA (USA, CA) TEL: 1-510-7709899 FAX: 1-510-6231803
ADDA (CANADA, BC) TEL: 1-604-2783224 FAX: 1-604-2782909
ADDA (TAIWAN) TEL: 886-2-2484131 FAX: 886-2-2484276, 886-2-2404538

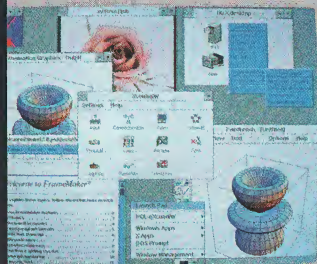
All the trade marks are the property of their respective holders.

EXCEED THE LIMITS OF X TERMINAL EMULATION.

Turn your PC into
an X station.

With HCL-eXceed/W
X server software,
Hummingbird allows you
to live in two worlds:
MS-DOS/MS-Windows and
UNIX/Windows/UNIX.

Imagine being able to
live both text and images
between UNIX hosts and your
PC. It's as simple as
copying and pasting from
a window of your PC screen
to another.



Discover other innovative
capabilities of HCL-eXceed/W.
Launch Pad menuing facility
Telnet and FTP applications
X11 R5: support for scalable
fonts, font servers,
XDMCP security
Start — X client program
Tracer — protocol tracing
facility
Single window and multiple
window mode
Supports 15 different TCP/IP
protocols and DECnet



- supports up to 16 million colors
- plane mask support

X Development Tools

HCL-eXceed/W
now includes the Xlib, Xt
intrinsic, Xaw and Xmu
libraries. This introduces a
whole new dimension to PC
X servers. Now you can
use your PC as a low-cost
workstation to develop and
run X applications. You
can also give other PCs
and workstations access
to these applications over
the network.

HCL-eXceed/W from
Hummingbird. It's far more
than X terminal emulation
for PCs. And it's one of
the family:

HCL-eXceed Plus — A
DOS-based X server with a
local window manager that
supports EGA, VGA and
Super VGA.

HCL-eXceed HiRes — The
same as "Plus" but it also
supports 8514A, XGA and
TIGA 2 high resolution
graphic standards.

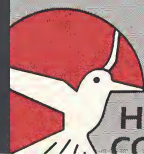
HCL-eXtend — UNIX host-
based X clients for accessing
DOS services.

For the name of your closest reseller, please contact:

2900 John Street, Unit 4, Markham, Ontario, Canada L3R 5G3
Telephone: (416) 470-1203, Fax: (416) 470-1207

In Europe: 37-39 rue de Vermont, 1202 Geneva, Switzerland

Telephone: 41 (22) 733 18 58, Fax: 41 (22) 734 14 79



**HUMMINGBIRD
COMMUNICATIONS LTD.**

Circle 135 on Inquiry Card

The BYTE Lab, Behind the Scenes

ALAN JOCH

The forward march of processing power combined with dropping prices continues to have a dizzying effect on PCs and workstations. This month, the BYTE Lab is filled with 486 systems that rank near the top of the performance curve. That so many systems meet this classification indicates that high-performance hardware lies within the reach of more people than ever. As the BYTE Lab Product Report makes clear, you can spend less than \$3500 today and walk away with a 486 that runs everything from basic word processing programs to Unix. The Solutions Focus, which heads up the reviews section, shows that the PC environment stands head-to-head for price and performance with leading RISC-based workstations.

This doesn't mean that PCs can do it all, of course, but 10 years after the XT legitimized the microcomputer, the platform continues to flourish.

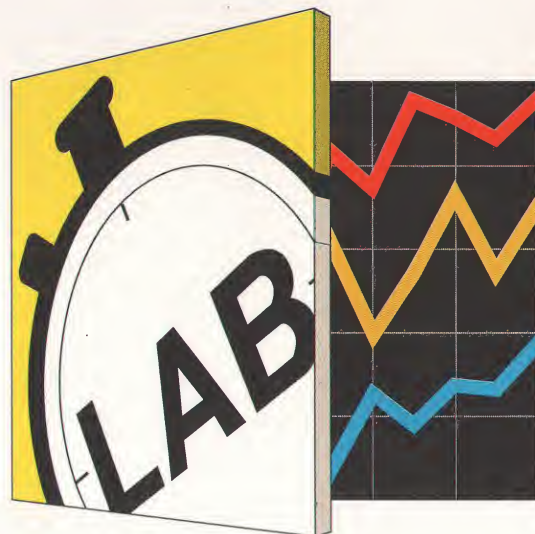
The bottom line is that the development of more-sophisticated hardware and software products is stronger than ever. So, too, are the challenges for those in the BYTE Lab who must learn new technologies and develop appropriate test methodologies to gauge a product's usefulness.

The significance of this hit home recently when we spent an afternoon with representatives of BYTE Brasil, the São Paulo-based computer magazine that publishes original material along with editorial from the flagship BYTE. This year's lifting of local trade restrictions will mean a legal flood of computers into that country. For BYTE Brasil, product evaluations will become an important service to its readers. How we built a testing facility and conduct evaluations on an ongoing basis became the foundation for many of the questions that afternoon.

Our Benchmarks

We're proud to have been the first computer magazine to develop benchmarks to rate computer performance. Our benchmark development continues: We've just finished expanding our Windows benchmarks, and we're working on new versions of Macintosh, Unix, NetWare, and DOS test suites. Over the next few months, we'll unveil these upgrades in evaluations that appear in these pages. We'll continue to publicly distribute the benchmarks, and

Testing today's hardware and software is more challenging than ever. Here's a look at how the BYTE Lab will be meeting that challenge.



we invite you to use them when you make buying decisions. We'd also like to hear your ideas for how we can improve our next generation of tests.

But while we believe in indexes and charts to quickly show how, for example, one 50-MHz 486 system ranks in performance against a competitor, readers demand more than simple numbers to understand the products we write about. Our testing editors have the technical expertise of some of the most talented programmers and engineers in the computer publishing field. They're also communicators. The same people who conduct BYTE Lab evaluations write the reviews that you see every month. That's the only way to get the hands-on insights that add power to benchmark numbers. This may sound obvious, but until recently, few magazine testing labs used the approach the BYTE Lab has been using all along.

Application-level tests have always been important in our testing, and in the future we'll emphasize them even more. The venerable BYTE Lab application-level benchmarks use commercial software to test how effective a particular product is for database applications, graphics, or word processing. We'll also spend more time doing field work, learning how professionals use a particular genre of products and what questions they'd like answered.

Looking at the BYTE Lab

This month's installment of Reviewer's Notebook launches a new format designed to keep you up to date with the BYTE Lab

as it evolves. We'll take you behind the scenes as we develop new testing methods and discuss important technological issues.

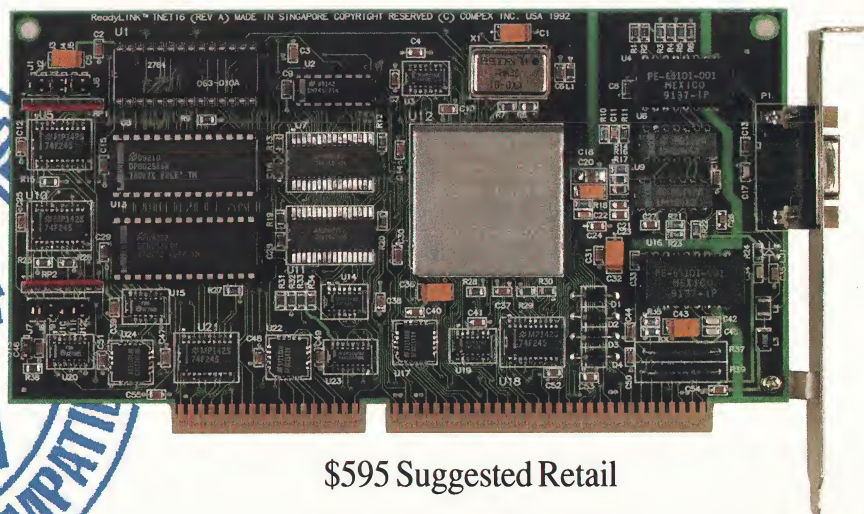
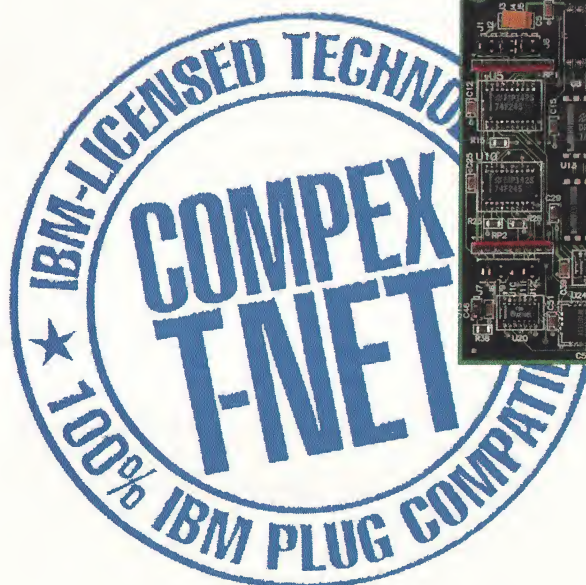
The reason for this new format is threefold. Through phone calls, E-mail, and letters, many readers have expressed the desire to look over the shoulders of BYTE Lab editors. Usually, these questions center on two important areas: how to decide if a particular product is right for your needs, and how to use the product most productively. Each month, those are the two primary issues we address as we develop a Solutions Focus, a roundup, and stand-alone reviews. This new format does not change the other way you have to get answers from the BYTE Lab: Ask BYTE, which has been addressing product and productivity problems for many years, will continue to field your specific questions.

By using this page to invite you into the BYTE Lab each month, we'll address specific issues relating to hardware and software testing. We also hope that you'll come to understand who we are and how we do our jobs, and develop greater trust in our recommendations. Finally, we'll provide a window to the future as we look at the latest technologies hitting the market.

Of course, this will work best if it's interactive: Let us know your questions, concerns, and insights about the subjects we deal with each month. Together, we'll advance the art of product evaluations. ■

Alan Joch is senior editor and director of the BYTE Lab. You can reach him on BIX as "ajoch."

NEW COMPLEX T-NET. FINALLY TOKEN RING THAT'S TRUE BLUE.



\$595 Suggested Retail

See us at
COMDEX/Fall '92
Las Vegas Convention Center
Booth # 4454

Until now, connecting non-IBM cards to IBM Token Ring meant the hassle of writing special drivers and a lot of tinkering.

But the new Complex T-NET™ Token Ring card ends all that. Because it's 100% plug-compatible with IBM.

T-NET is one of the first with National's hot TROPIC™ chipset that's true blue right down to the

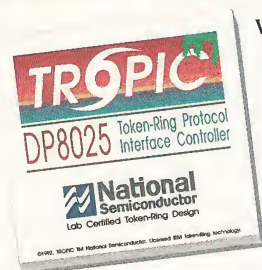
built-in Media Access Control software. And it's fast, too. Up to 25% faster than 8-bit Token Ring cards.

Sixteen bit ISA T-NET is available now. A MCA version will be available soon. And with a \$595 retail price, an IBM-compatible Token Ring network has never been so affordable.

Complex T-NET. First to market with IBM plug compatible Token Ring. That's

why resellers and users count on us to help them out-connect everything else.

Find out more!
(714) 630-7302
Fax (714) 630-6521



Out-connecting the rest

© 1992 Complex, Inc. Complex is a registered trademark of Complex, Inc. T-NET is a trademark of Complex, Inc. IBM is a registered trademark of International Business Machines Corporation. All other trademarks and copyrights acknowledged.

Why Unicode is 256 times better than ASCII for a global market.

The ASCII standard has 256 codes, not even enough for European characters and symbols. Introducing the encoding standard of the future – Unicode.

The 16-bit Unicode has more than 64,000 codes and over 30,000 allocated characters. Just think what this single, complete and interchangeable character set lets you do. Encompass all languages. Transcend every computer architecture and platform. Cross every culture and border. Avoid the arbitrary local-language codes and data integrity problems that have kept countries from transferring and sharing information easily.

Unicode also conforms with internationally accepted ISO standard 10646 to protect your software investment. No wonder major computer and software companies already support Unicode. They've seen tomorrow's world and know ASCII isn't big enough for it.

Find complete explanations and codes in *The Unicode Standard, Worldwide Character Encoding, Version 1.0*. Volume 1 contains codes for: Latin, Cyrillic, Greek, Hebrew, Arabic, as well as other European, African and Indian alphabets. Volume 2 has codes for Japanese, Chinese and Korean writing systems.

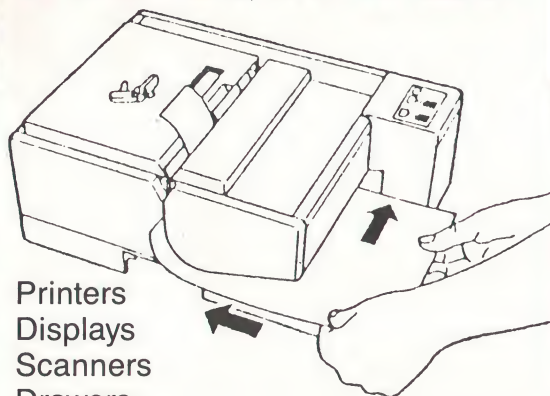
Enquire at your bookstore or call Michel Suignard, Unicode Europe, at +33-1-46351058.



The Unicode Consortium

Attend the
Unicode/ISO 10646
Implementers
Workshop
3-4 December, 1992
Sulzbach (Frankfurt),
Germany
Telephone
+49-6196-991259

POS-EQUIPMENT



Printers
Displays
Scanners
Drawers

PC Card which turns your PC
into a POS Terminal

dietrich SINCE 1928

Zaehringstr. 326
D-7800 FREIBURG / Germany
Phone 49-761-552719 • 54915
FAX 49-761- 5 68 81

Real-Time Multitasking

for Microsoft C, Borland C, Turbo Pascal

Develop Real-Time Multitasking Applications with RTKernel!

RTKernel is a professional, high-performance real-time multitasking kernel. It runs under MS-DOS and supports Microsoft C, Borland C++, Turbo Pascal, and Stony Brook Pascal*. RTKernel is a library you can link to your application. It lets you run several functions / procedures as parallel tasks. RTKernel offers these advanced features:

- pre-emptive, event- / interrupt-driven scheduling
- number of tasks only limited by RAM
- task-switch time of approx. 6 µsecs on a 33-MHz 486
- speed independent of the number of tasks
- use up to 64 priorities (changeable at run-time) to control your tasks
- time-slicing can be activated
- programmable timer interrupt rate
- inter-task communications using semaphores, mailboxes, and message-passing
- call DOS without re-entrance problems
- activate tasks out of interrupt handlers
- interrupt handlers for keyboard and COM ports included with source code
- supports math coprocessor and emulator
- resident multi-tasking applications (TSRs)
- keyboard, hard disk, floppy disk idle times usable by other tasks
- runs under MS-DOS 3.0 to 5.0, DR-DOS, Novell, etc., or without operating system
- ROMable
- supports CodeView and Turbo Debugger

New Features of Version 3.0:

- supports 36 COM ports (and NS16550)
- fast, inter-network communication using Novell's IPX services
- runs Windows or DOS Extenders as a task
- programmable interrupt priorities
- full source code available
- no run-time royalties
- free technical support by phone or fax

RTKernel-C (MSC 6.0/7.0, BC 1.0/2.0/3.0) DM 795 (for source code, add DM 695)
RTKernel-Pascal (TP 5.0/5.5/6.0, SBP 6.0) DM 695 (for source code, add DM 595)

For international orders, add \$30 for shipping and handling. 30-day money-back guarantee available to qualified customers.
MasterCard, Visa, check, bank transfer, COD (in Europe) accepted.

Please call or fax for our free demo disk.

On Time
MARKETING

KARSTEN PETERSEN

Karolinenstrasse 32 • D-2000 Hamburg 36 • Germany
Phone +49 - 40 - 43 74 72 • Fax +49 - 40 - 43 51 96

A solution tailoured for perfect text recognition.

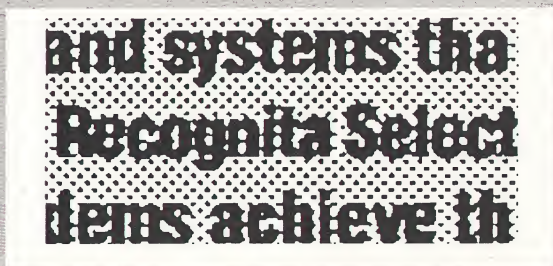
The question is ...

If you are looking for a solution that will put an end to all those unnecessary hours of re-keying the already printed copy, and a technique that will also be able to retrieve the copy and edit it. And whilst doing this be cost-effective, accurate, fast, versatile and efficient, then look no further.

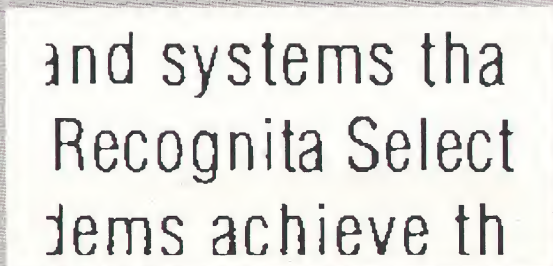
We have the answer ...

Hewlett-Packards ScanJet IIP scanner with HP AccuPage Technology and Recognita Select.

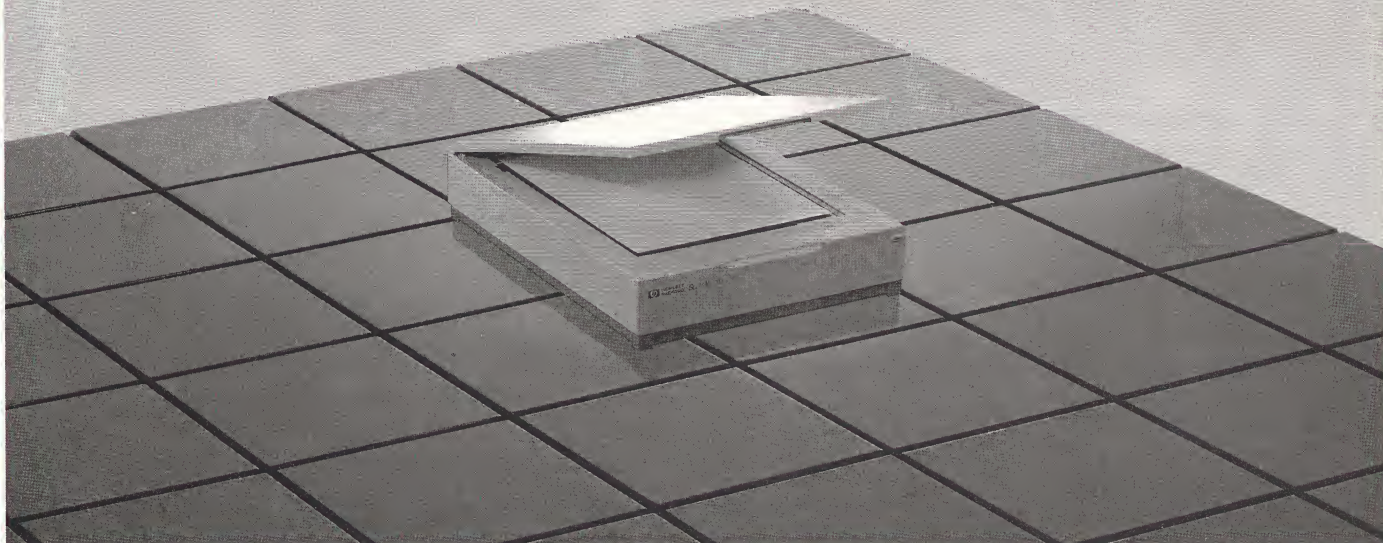
HP ScanJet IIP with HP AccuPage is optimized for OCR (optical character recognition). HP AccuPage sets intensity automatically to deliver the highest quality image and clears the background of text from any stains or trash delivering sharp and well defined character shapes for Recognita Select OCR software. HP AccuPage technology used with Recognita Selects multilingual text recognition abilities make a superb combination that simply meets every demand.



Scanned image without HP AccuPage technology



Scanned image without HP AccuPage technology



SZKI Recognita Corp.

Tel: (36-1) 201-8452
Fax: (36-1) 201-7607



Recognita Corp. of America

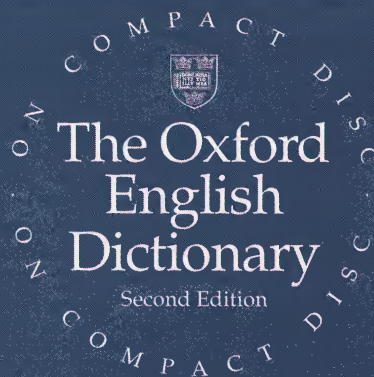
Tel: (408) 241-5772
Fax: (408) 241-6009



**HEWLETT
PACKARD**



Tel: 415-692-9061
Fax: 415-692-9064



the history of the language from
1150 until the present

over half a million headwords
defined

2.4 million quotations

linguistic origins traced from over
one thousand languages

'invaluable for anyone who uses English in their work.' BYTE

'a completely wonderful piece of software.' THE INDEPENDENT

*'Researchers, librarians and writers in all fields will want to own
the world's greatest dictionary in CD-ROM format'*

WINDOWS MAGAZINE

'one of the major technological achievements of the century.'

ANTHONY BURGESS

The internationally recognized
authority on the usage and
meaning of English words and
phrase from 1150 to the present is
now available on compact disc.

Superb search-and-retrieval
software allows you to explore the
world's most authoritative
dictionary of the English language
in unprecedented ways.

However you use the Dictionary –
as a detailed reference work or
for pure enjoyment – the
Compact Disc edition releases its

encyclopedic potential, ensuring
hours of entertainment and
education.

A Windows application for IBM
386 PCs (and full compatibles).
Price: £495 (plus VAT and
postage).

For your free brochure,
or to order, call or write to:
**Janet Caldwell, at
Oxford University Press,
Walton Street, Oxford OX2 6DP
Tel: 0865 267979,
Fax: 0865 56646**



Save on Discount Software

Shipped Worldwide!

- Popular and hard-to-find titles.
- All software guaranteed new
and vendor-sealed.
- We also sell peripherals.
- Fast, courteous service.
- Low shipping rates.

Call or Fax today for prices
Phone (916) 677-7795 or Fax (916) 676-8524
(West Coast USA time Zone)



Omni+ Plus

6430 Quiescence Lane, Suite "C"
Carmichael, Ca 95608

SA-9600 Stand-Alone Radio Modem

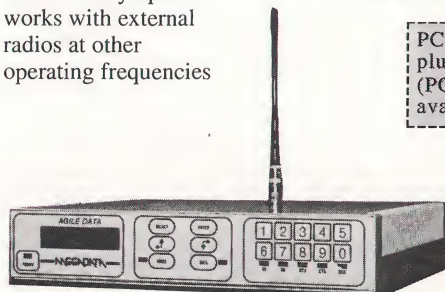
- ☐ Async/Sync RS-232 interface
- ☐ 2400, 4800, 7200, 9600 BPS
- ☐ Encryption capable
- ☐ Up to 15-mile range,
hundreds of miles with repeaters/amplifiers
- ☐ Full or Half Duplex
- ☐ Voice and DC POWER options

up to 38,400 BPS async
w/data compression option

Wireless Data Communications for Micros, Minis and Mainframes

- ☐ Transparent radio link—
no software modifications
- ☐ Modem-only option
works with external
radios at other
operating frequencies
- ☐ 400-500MHz Band
(FCC CERTIFIED
450-470MHz)

PC-compatible
plug-in board
(PC-9600) also
available



MEGADATA

Tel: (01) 516-589-6800
Fax: (01) 516-589-6858
35 Orville Drive, Bohemia NY USA 11716

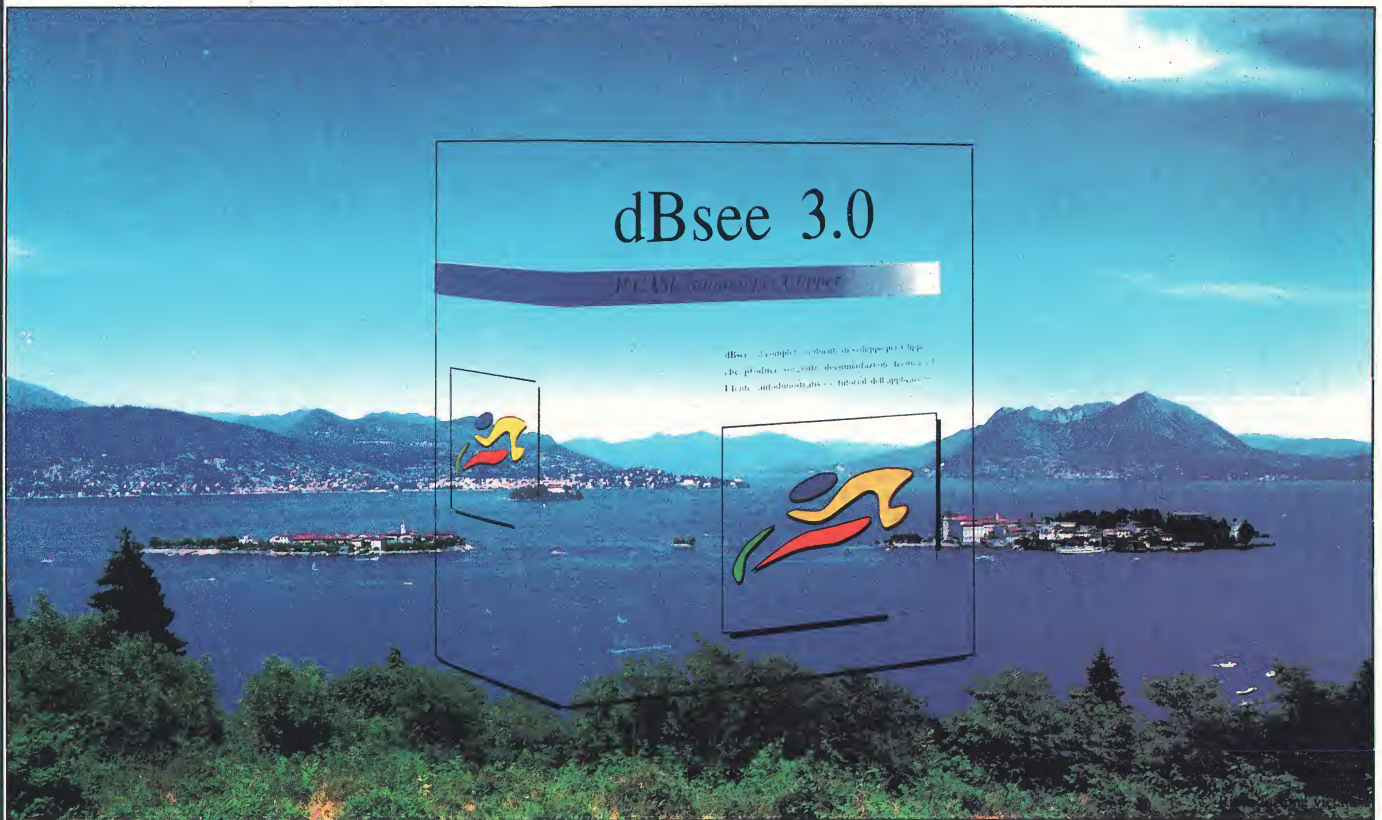
dBsee 3.0

The standard CASE for Clipper

The ideal instrument for software development and maintenance in Clipper, and for the production of technical and user documentation.

dBsee 3.0 brings cost and time savings of up to 90% compared to traditional development methods.

The proven solution for companies who want to optimize and standardize their software development projects.



dBsee 3.0 is the complete development environment for Clipper, able to support every stage in the development of an entire software project in Clipper, to maintain it and to produce the related technical and user documentation.

The prototype definition, source generation and software documentation stages are supported by perfectly integrated and dedicated instruments. The user interface is easy to understand and simple to use. The many available functions, which vary with the context, are selected using a pushbutton menu or hot keys for the more experienced operator. dBsee 3.0 generates sources using special files known as **Templates**, using one for each type of source that needs to be developed (data entry forms, windows, queries, reports, etc...). The programmer can access and modify the templates to align automatic software development with different company development standards.

The highly modular structure of the whole development environmental and of the generated sources makes it possible for the programmer to manually enter source code blocks in many points of the automatically

generated sources. The modifications are identified, saved and restored in successive automatic generations using **Reverse Engineering** techniques.

Technical features

The design of the data entry forms allows one to use:

say - get - functions - expressions - memo fields - semi-graphic fonts - boxes etc. - conditional display and edit - multi-level look-up windows on every encoded field with data-entry facility for data not present in file - selective refresh of screen fields - virtual screen for data entry management of formats of up to 65,000 lines by 65,000 columns - windows with horizontal and vertical scroll - printer/screen/color configuration. The generated applications feature **Contextual Help** and windows which facilitate the search on encoded information.

Reports. Unlimited number of scanned files - up to 9 grouping levels plus general total. Print attributes for every item (bold, underline, italic, etc) - Summarising computations (min, max, total, mean, variance, standard deviation, range).

Local Area Network. The developed applications can be generated to operate in Local Area Networks. File/record/logical lock for multiuser access.

Complete technical documentation on developed projects: data dictionary, symbols cross-references of screens and reports, User Manual.



Circle 427 on Inquiry Card.



Call us for a free demonstration disk.

For further information please call

++39-323-922066/925356 (Ask for Michela)

ISA srl Italian Software Agency Via Torino, 2 28042 Baveno (NO) Italy
Tel. ++39 - 323 - 922066 - 924239 - 925356 Fax: ++39 - 323 - 925208

BOOK AND CD-ROM REVIEWS

HUGH KENNER

A sequence to ponder: 1876 ("Mr. Watson, come here; I want you"), and then 1878 ("First teenage males flung off phone system by enraged authorities"). The teenagers were Bell's first telephone operators, and the litany of their misdeeds resounds down the decades. They talked back to subscribers, took Saint Patrick's Day off without getting permission, but worst of all, "played clever tricks with the switchboard plugs, disconnecting calls, crossing lines so that customers found themselves talking to strangers."

"This combination of power, technical mastery, and effective anonymity seemed to act like catnip on teenage boys." In *The Hacker Crackdown: Law and Disorder on the Electronic Frontier*, Bruce Sterling next adduces the hacker culture of the 1990s. Verily, some things never change.

Sterling was coauthor, with William Gibson, of last year's novel *The Difference Engine*, about a Victorian England in which Babbage's machine has succeeded (and John Keats lives, a wizard programmer). Gibson, in 1982, had coined the word *cyberspace*, the sort of word that can annoy in the absence of firm agreement about its scope. Here's Sterling to the rescue: Cyberspace is "the 'place' where a telephone conversation appears to occur." Not inside one phone or another; no, "the place between the phones. The indefinite place out there, where the two of you, two human beings, actually meet and communicate."

For decades, cyberspace was a darkness defined by sound. Today, awash in light from computer screens, it's routinely inhabited by "quite normal people," even civil servants. "We do not really understand how to live in cyberspace yet," and *The Hacker Crackdown* is about "certain strange events in the year 1990," when cops carried seized computers out of dozens of doors and some owners never did find out what, if anything, they were charged with.

There's a surreal interlude when a registered Republican (and Grateful Dead lyricist) finds himself, on his ranch in



AMOK IN CYBERSPACE

**The Hacker Crackdown:
Law and Disorder
on the Electronic Frontier**

Bruce Sterling

Bantam Books, \$22.50,
ISBN 0-553-08058-X

Wyoming, explaining "the very nature of computer crime to a head-scratching local FBI man who specialized in cattle rustling." And there's a wry subclimax when a young man is on trial for stealing from Southern Bell a document valued at \$79,449, and after pages of skillful narrative foreplay, our author spreads before us nothing less than the radioactive document itself: mere grim lists of who's responsible for what in the 911 number system. And for this, jail impends? (Moreover, there was nothing to steal. The document was in the public domain.)

What makes the book work much better than such lurid details suggest is the third of its four parts, "Law and Order." There, Sterling spends time with the Bad Guys, those who seize the equipment of innocents and scare the guts out of bewildered teenagers. And they're feisty, and they talk sense, and it's not a black-and-white

world. It's riven by conflicting coordinate systems.

Gail Thackeray, "a trim blond Baby Boomer who favors Grand Canyon white-water rafting to kill some slow time, is one of the world's most senior, most veteran hacker-trackers." She shares computer fever with her targets, longing for access to "an Amiga 2000 with IBM card and Mac emulation!" And four pages from the end, we are privy to a moving moment in San Francisco.

Ms. Thackeray is at the same party as the kid who was almost juggled over that Southern Bell document. She turns on him "the full lighthouse glare of her attention and begins a determined half-hour attempt to win the boy over." His future should be with her! His skills should be Prosecuting Computer Crime! He's listening with unfeigned attention, saying yes, ma'am.

Too soon yet for a symbiosis. But give both camps, say, another decade.

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. His recent books include Mazes and Historical Fictions. You can contact him on BIX as "hkenner."

INSIDE GRAPHICS FILES

Graphics File Formats, David Kay and John Levine, Windcrest, \$24.95, ISBN 0-8306-3059-7.

Graphics File Formats won't keep you glued to your seat, nor will it provide you with masterful insights into the inner workings of graphics applications. It will, however, come in handy if you ever need to decode or understand any of the common graphics file formats. The book helps developers decide which graphics standards are most appropriate for their applications. Each format description is accompanied by a section listing the format's advantages and disadvantages.

CompuServe's GIF, for example, can be used to exchange images between widely differing input and output devices. It's widely supported on numerous platforms, and it supports 24-bit color and images of up to 65,536 by 65,536 pixels. On the downside, GIF can have only 256 24-bit colors and cannot store gray scales or color-correction data. Also, it does not store CMYK or HSI model data. Similar feature lists are provided for all formats.

Exploring the depths of graphics file formats is probably not on your daily task list. However, after reading this book, you'll understand the appropriate uses of each format, and the detailed description is sufficient for you to rummage around inside many of the graphics files and determine how they operate. This is the type of voyage of discovery I enjoy.

—Raymond GA Côté

LITERATE LISTINGS

Literate Programming, Donald E. Knuth, University of Chicago Press, \$24.95, ISBN 0-937073-80-6.

While you're waiting for Donald Knuth's fourth volume of *The Art of Computer Programming*, pass the time reading this new collection of Knuth classics. *Literate Programming* gathers an even dozen pearls, ranging from his 1974 Turing Award address titled "Computer Programming as an Art" to contemporary works on Web and Tex.

The title refers to Knuth's current quest for readable programs. "All of the major problems associated with computer programming—issues of reliability, portability, learnability, maintainability, and efficiency—are ameliorated when programs and their dialogs with users become more literate." In short, computers are fully capable of properly deciphering the most amazing mélange of uncommented, poorly spaced code with indecipherable variable names. If, however, the focus changes from writing code for the computer to writing code for other programmers, the result becomes like literature rather than programming.

While the first half of the book presents the whys and wherefores of Knuth's move to literate programming (and includes one of my favorite Knuth essays, "Structured Programming with go to Statements"), the second half consists of views into Tex, a typesetting program, and Web, a literate programming environment in which Tex is written.

Reading others' code is a learning experience. By doing it, you can increase your own repertoire of algorithms and solutions. The key is that the reading should be enjoyable as well as educational. Much less is learned from having to wade through turgid code than by sitting down with a good algorithm in front of a warm fire.

—Raymond GA Côté

MORE MAC SECRETS

Macintosh Programming Secrets, 2d ed., Scott Knaster and Keith Rollins, Addison-Wesley, \$29.95, ISBN 0-201-58134-5.

Scott Knaster wrote the original *Macintosh Programming Secrets*, an enjoyable amalgam of loopy humor and little-known Mac programming techniques. Now he teams up with Keith Rollins to write a second edition. Most of the material is new. And it is the good stuff.

It includes sample code for a movable modal dialog box, a progress indicator (like that used by the Finder during a file copy), intelligent window redrawing using off-screen buffers, and a file copy program that illustrates use of the File Manager. There's also a discussion of stand-alone code (the stuff of INITs, XCMDs, and WDEFs) with sample code, and a nifty Command-period abort dialog box that gives you control of the computer no matter what by sneaking a look at the Mac's event queue. The Knaster humor is still there, making an esoteric subject interesting. This is a must for the Mac programmer's bookshelf.

—Tom Thompson

DIAL SOS FOR SUPPORT

Support on Site, \$1295 from Computer Library (1 Park Ave., New York, NY 10016, (212) 503-4400; fax (212) 503-3695).

Unless you have had firsthand experience as a technical-support professional, you can never imagine how wide-ranging, challenging, esoteric, and downright flaky some support requests can be. Supporting a large group of users requires a broad knowledge of applications and hardware, a shelf full of reference materials, and personality traits such as patience, persistence, and a sense of humor.

The new Support on Site series from Computer Library puts all the reference materials in one place. The first title to be released, SOS for Applications, packs a large reference set onto a single CD. Computer Library updates it monthly with material from software manuals, technical notes, newsletters, and even program code fixes and software drivers. An annual subscription sells for \$1295 (single user) or \$4995 for the LAN version (five concurrent users).

Computer Library is still building up the product's content, but it has already covered many popular programs, including Windows 3.1 and OS/2; dBase for the PC; and the PC and Mac versions of Lotus 1-2-3, WordPerfect, and Excel. As of the August edition, coverage of PC applications far outnumbered Mac product references.

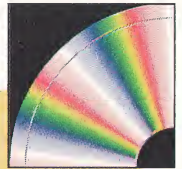
SOS is packed with valuable tips, fixes, and workarounds, but organizationally it appears as a hodgepodge of technical data from divergent sources. As such, it's less accessible than other reference works. Although each document contains a header of descriptive fields, much of the information just doesn't lend itself to simple classification.

Accessibility of information is crucial in support work, where you rarely look for a clearly defined subject. You usually research complex problems involving many hardware and software elements, and it's hard to encapsulate such problems in a simple search.

The search-and-retrieval software starts with a field template to narrow your search to a particular application or publication. From there, you can use Boolean operators (i.e., AND, OR, and NOT) to create search expressions. You can also negotiate proximity searches, looking for *Windows* within 10 words of *network*, for instance. Anyone familiar with the interface of Computer Library's Computer Select CD-ROM will feel right at home with SOS.

This is not a CD for browsers or nontechnical users. The structure and content are not accessible enough to accommodate casual use. However, technical-support professionals will find SOS useful as a comprehensive reference tool and a way to keep up with the steady stream of technical updates. ■

—Stanford Diehl



Allow us to crank up the volume on your PC.



Just when you thought you had us pegged for building fiery-hot graphics cards we decide to throw a curve ball. And this one's aimed directly at your ears: the new Orchid Sound Producer Pro. An easy-to-load board that features a phenomenal 20-voice synthesizer, delivers sampling rates up to 44.1 KHz and is 100% compatible with SoundBlaster Pro, along with three other sound standards—Disney Sound Source, AdLib and Covox Speech Thing. MIDI support, joystick port, microphone, speakers and our exclusive Voice Notes (for audio post-its) are bundled for an absurdly low \$199. For more details, call 800-7-ORCHID. Or fax: 510-490-9312. And prepare to sample true audio ecstasy.

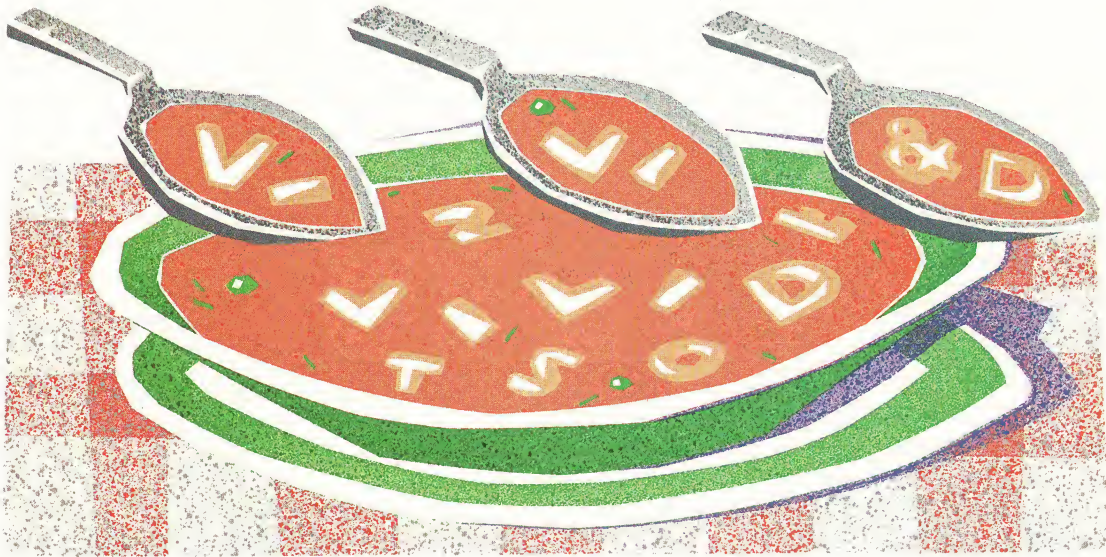


©1992 Orchid, Sound Producer and Voice Notes are trademarks of Orchid Technology. All other trademarks are owned by their respective manufacturers.

Circle 161 on Inquiry Card (RESELLERS: 162)

UDI MANBER
AND SUN WU

APPROXIMATE PATTERN MATCHING



The meeting with the famous Dr. Kruschel was two months ago, and you distinctly remember writing down an important idea and filing it under *Kruschel*. Or was it *Krushel*? No, *Kruchell*. Can't find it. How about *Kruchal*? Oh, no, this idea is crucial now, and there are just too many spelling possibilities!

If the amount of data you have is small, you may be able to look everywhere (e.g., you can look at all names that start with *K*). But if you have megabytes' worth of text and the only way to find something is by searching for names, technical terms, or other keywords or patterns, a typo may be equivalent to dropping a folder behind the filing cabinets—it's virtually lost.

Searching text through pattern matching is a common operation in many applications, ranging from word processing to molecular biology. But sometimes the pattern does not appear in the text exactly, and errors in the text or in the query can result from problems like misspellings or transmission errors. Most text editors and search programs do not support approximate searches because of the complexity involved in implementing such a procedure. But some new algorithms may change that.

Below, we describe one such algorithm in sufficient detail to enable you to include it in your own programs. We also describe *agrep*, a Unix software tool for approximate pattern matching that we developed. *Agrep* includes many options that make searching powerful and convenient.

Imagine how nice it would be if you didn't have to write down the exact spelling of everything. Instead of guessing all the possibilities every time you need to spell *Kruschel*, you can just try something similar and let the program find out the right spelling. If you use *agrep*, you can search approximately for *Kruchel* in a whole directory (or even several directories), and instead of getting No match, you might get The best match has 1 error; there are 4 such matches; do you want to see them?

Think of a system that automatically suggests alternatives every time it sees a word it doesn't understand. If you typed `cd pesonal/travel/Massashusetts/hotels`, the system would not reply `pesonal/travel/Massashusetts/hotels: No such file or directory`. Instead, it might say, do you mean `personal/travel/Massachusetts/hotels`? Such systems can't come soon enough for those of us who can't type or spell well. Approximate matching is useful, fast, and not too hard to do.

Exact String Matching

The first thing you must do when designing an algorithm is define the problem precisely. Often, it's best to start with the simplest nontrivial variation of the problem and go from there. As Einstein once said, "Make it as simple

Agrep finds patterns even when you can't remember the exact spelling

as you can, but not simpler than that." So we'll forget the word *approximate* for a moment and concentrate on exact string matching.

We represent the text and the pattern as sequences of *characters*. Think of the characters as English characters, but they can be any symbols, such as DNA base pairs, lines of source code, angles between edges in polygons, or music notes and tempo in a musical score.

We'll denote the text by $T = t_1 t_2 \dots t_n$, and the pattern by $P = p_1 p_2 \dots p_m$. Generally, n is much greater than m . The basic string-searching problem is to find all occurrences of P inside T .

The straightforward solution to this problem is to start by comparing p_1 to t_1 and continue (comparing p_2 to t_2 , and so on) until we either complete the match or find a mismatch. In the latter case, we must go back to the place from which we started the match (t_1 at first), move on one character (to t_2), and try again. This process is illustrated as shown at right. The pattern is *vivid*, and the piece of text we are searching in is *vivi&dv&vivid*.

We've indicated mismatches in bold type. The first four characters match, but

the fifth does not. We cannot continue matching from *&*, because the third and fourth positions in the text (*vi*) match the beginning of the pattern and may be the start of a complete match. We have to try every beginning as shown.

```

vivi&dv&vivid
vivid
 v
  viv
   v
    v
     vi
      v
       vivid

```

Boyer-Moore Filtering

There are many ways to improve on this straightforward solution. The two most famous ones are the Boyer-Moore algorithm and the Knuth-Morris-Pratt algorithm (see Gonnet in the bibliography).

The Boyer-Moore algorithm is usually the fastest algorithm for exact string matching. It has many variations, but the main idea is this: The first comparison is not between the first character in the pattern and

the first character in the text, but between the *last* character of the pattern and the *m*th (fifth in our case) character in the text.

In our example, we would compare *d* to *&*; we have a mismatch right away, so we can shift the pattern. The key idea is to look at the character in the text that caused the mismatch (in this case, *&*) and see where this character can fit in the pattern. *&* does not appear at all in our pattern; therefore, we can safely shift the whole pattern m positions to the right.

The next comparison is between the last character in the pattern and the tenth character in the text (moving m steps from the fifth position). The tenth character is *i*, which does appear in the pattern in the second and fourth positions. The only safe shift is by one, because the *i* in the text may match the fourth position in the pattern; so now we look at the eleventh character in the text, *v*, which appears in the pattern in positions 1 and 3.

The safe shift now is by two (which is the size of the pattern minus the last position of the text character in the pattern). That gets us to the thirteenth character, *d*. Now we have a match of the *ds*, and we continue, backward, to check whether the

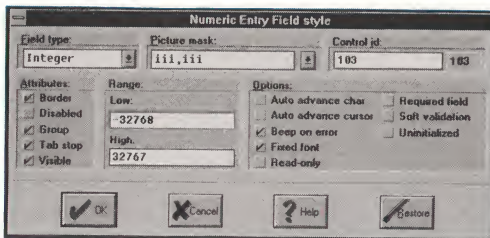
Professional Windows Data Entry for TPW and C++

Validated Entry Screens...Build Them Interactively!

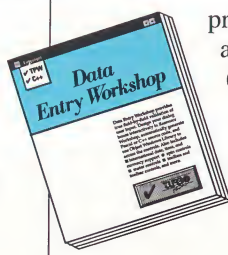
Data Entry Workshop's custom edit controls provide true field-by-field validation of user input for Microsoft Windows applications. It's as easy as 1-2-3:

1. Design your dialog box interactively in Resource Workshop.
2. Run MAKESRC utility to generate Pascal or C++ source code.
3. Use ObjectWindows Library to access your controls.

Use picture masks for precise control of input. Offer calculator-style editing of numeric data. Adapt easily to international differences in date, time, and currency formats. Add calculated, read-only, or required fields. Add spin controls to let users increment and decrement fields with the mouse or cursor keys. Data Entry Workshop gives you the tools you need.



Resource Workshop dialog for designing a numeric entry field.



You also get:

- ☐ Meter controls for use in installation programs.
- ☐ Toolbox and toolbar controls to give your users one-click access to common commands.

Full Source and Great Support

Data Entry Workshop includes comprehensive printed documentation, plenty of working example programs, and support direct from the authors. Full source code is included (DLLs are in Pascal). You pay no royalties.

**Data Entry Workshop,
only \$189.**

Call toll-free to order.

1-800-333-4160

DEW requires TPW 1.5 or later, BC++ 3.0 or later, or TC++ Win 3.0 or later, RW 1.02 or later, and OWL. Satisfaction guaranteed or your money back within 30 days. Includes dual media. Add \$10 per order for shipping in US and Canada, add \$20 per item for international airmail. Owners of TurboPower DOS products may purchase DEW for \$109 until 10/30/92.



9AM - 5PM MST Monday through Friday, U.S. and Canada.
For more information call (800) 333-4160, fax to (719) 260-7151,
or send mail to CompuServe ID 76004,2611. Int'l orders (719) 260-9136.
TurboPower Software PO Box 49009 Colorado Springs, CO 80949-9009
© TurboPower Software, 1992

When storms hit the Gulf, Texaco keeps the gas pumping...



With RealFlex™, the QNX-based SCADA package by BJ Software Systems (a division of Baker CAC), operators can monitor and control remote well head devices throughout the Gulf of Mexico.

QUANTUM SOFTWARE SYSTEMS LTD.
175 TERENCE MATTHEWS CRESCENT
KANATA, ONTARIO, CANADA K2M 1W8
TEL: 613-591-0931
FAX: 613-591-3579

QNX IS A REGISTERED TRADEMARK OF QUANTUM SOFTWARE SYSTEMS LTD. REALFLEX IS A TRADEMARK OF BJ SOFTWARE SYSTEMS. © QUANTUM SOFTWARE SYSTEMS LTD. 1992



REALTIME OPERATING SYSTEM

... thanks to QNX®

Severe storms used to put a real damper on offshore operations, especially when personnel had to be evacuated from production platforms. And without operators, the platforms just sat idle until the skies cleared.

The bottom line is that shutting down production can cost \$1.5 million per day.

But that was before STORMAC (System for Texaco Offshore Remote Monitoring And Control).

With this SCADA system, operators can now monitor and control offshore devices in real time from the safety of a land-based control center.

Texaco now maintains offshore gas production 24 hours a day, whatever the weather.

The QNX Operating System plays a key role in the STORMAC success story. Since QNX delivers *real* realtime performance, PC SCADA packages like BJ Software's RealFlex™ can compete with costly high-end hardware systems.

From its unique modular architecture to its transparent fault-tolerant network, QNX gives system designers a host of high-performance advantages. And as a POSIX-compliant OS, QNX follows *the* standard in system portability.

SCADA. Robotics. OLTP. POS. With an installed base of nearly 200,000 systems worldwide, QNX is the OS of choice for mission-critical applications.

To find out how QNX can help you develop responsive realtime solutions, call 1-800-363-9001 (ext. 101).

Architecture makes the difference.™

Circle 178 on Inquiry Card.

whole pattern matches (which it does, in this case). If there is a match of the last few characters and a mismatch in the middle, we can shift by one, as in the straightforward algorithm, or use other techniques for determining a better shift.

The main advantage of this method is that most of the time there will be mismatches that will lead to large shifts. In our example, only eight character comparisons are used, versus 20 comparisons for the straightforward method. We re-

cently extended the Boyer-Moore approach to approximate matching, and it is used in some parts of the latest version of *agrep*. But other parts use a much more general and elegant algorithm, based on a remarkable algorithm by Baeza-Yates and Gonnet (see the bibliography).

The Shift-AND Algorithm

Assume for the moment that you're looking not only for all matches of the pattern, but also for all matches of all prefixes of

the pattern. This requires much more information; but, as is sometimes the case in algorithm design, more is easier to obtain.

In our example, we are looking for all occurrences of five patterns: *v*, *vi*, *viv*, *vivi*, and *vivid*. We build a table that will indicate, for each position in the text, whether this position is the end of any of these five patterns. For each text position, we will have a bit array of size 5, such that the *k*th bit is 1 if this position is the end of a match to the *k*th prefix. Overall, the table will consist of *m* rows and *n* columns of bits:

```
vivi&dv&vivid
v 1010001010100
i 0101000001010
v 0010000000100
i 0001000000010
d 0000000000001
```

We are mainly interested in the last row, which indicates a match to the whole pattern, but the other rows will become important shortly.

Let's formalize what we've done so far. We denote by R_j the *j*th column of the table. R_j is a bit array of size *m*, such that $R_j[k] = 1$ if the first *i* characters of the pattern exactly match the *k* characters preceding and including t_j in the text (i.e., if $p_1 \dots p_k = t_{j-k+1} \dots t_j$). The question is how to evaluate this table quickly. The first observation is that the *j*+1st column depends only on the *j*th column, the pattern, and t_{j+1} . For example, there is a match for *viv* at *j*+1 only if there was a match for *vi* at *j* and $t_{j+1} = v$. In other words,

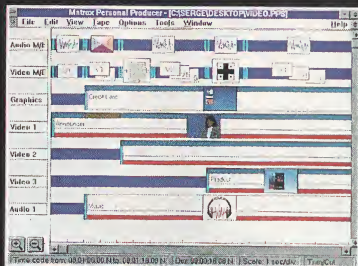
$$R_{j+1}[k] = \begin{cases} 1 & \text{if } R_j[k-1] = 1 \\ & \text{and } p_k = t_{j+1} \\ 0 & \text{otherwise} \end{cases}$$

Initially, $R_0[k] = 0$ for all *k*, $1 \leq k \leq m$, and $R_j[0] = 1$ for all *j*, $0 \leq j \leq n$.

The recurrence above can be translated directly into a program that requires one IF statement to compute each entry in the table. But we can do much better. If the pattern's size is no more than 32, we can represent each column (which is just a bit array) as one computer word. As we show next, a whole column can be computed quickly.

Look at columns 1 and 2 in the example above. There are two conditions to have 1s in column 2: (a) 1s can be only at positions where there is an *i* in the pattern (because $t_2 = i$), and (b) a 1 can be at a given position in column 2 only when the previous position in column 1 was a 1. Condition *a* ensures that the last character (t_2 , in this case) matches, and condition *b*

PROFESSIONAL VIDEO PRODUCTION ON YOUR PC...



AS LOW AS \$2,995

Discover a full range of solutions that combine state-of-the-art hardware with our easy-to-use Windows® video editing application, **Matrox Personal Producer**. Meet your budget and production goals.

- Edit video
- Create stunning true color graphics and titles
- Edit and synchronize audio
- Add dazzling digital video effects
- Perform amazing transitions
- Use lots of compatible products from third parties
- Print your video tape automatically

Let's talk about the system that's right for you!
Call now: (800) 361-4903
 or: (514) 685-2630



FREE SOFTWARE
 Inscribe/CG titler and Tempura Pro paint now bundle with Matrox Personal Producer.

matrox
 VIDEO PRODUCTS GROUP

Matrox Video Products Group
 1055 St. Regis Blvd., Dorval
 Quebec, Canada H9P 2T4
 Fax: (514) 685-2853

Matrox is a registered trademark of Matrox Electronic Systems, Ltd. Personal Producer is a trademark of Matrox Electronic Systems, Ltd. All trademarks and registered trademarks held by their respective owners are hereby acknowledged.

DON'T GO TOO FAR!



Computers

Floppydrives

LAN products

Keyboards

U.P.S.

Printers

Notebooks

Digitizers

Monitors

Harddisks

Peripherals

Plotters

Cases

Mainboards

ECG

EUROPEAN COMPUTER GROUP

YOUR EUROPEAN PARTNER

Your business is safe with us!



European Headquarters:
European Computer Group B.V.
P.O. Box 116
5710 AC Someren
Netherlands
Tel.: 31-4937-90005
Fax: 31-4937-96808

Circle 425 on Inquiry Card.

**DEALERS OEMS
DISTRIBUTORS WANTED**

A Message to Our Subscribers

FROM TIME TO TIME WE MAKE THE BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled

BYTE Magazine
Attn: Subscriber Service
P.O. Box 555
Hightstown NJ 08520

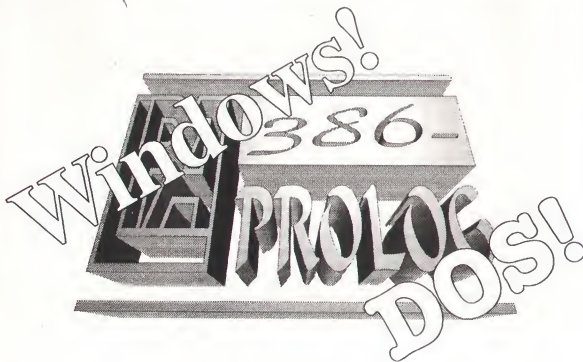
use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict

the use of your name, simply send your request to the address at left.



32 Bits!



That's right: a nice, fat 32 bits! Available both for Windows 3.1 and DOS, LPA 386-PROLOG gives you an easy to use, menu and window based programming environment. And thanks to the genuine 32-bit flat model architecture, your applications can directly address up to 4G (4096M) of memory (64M under Windows).



Logic Programming Associates Ltd
Studio 4, Royal Victoria Patriotic Building
Trinity Road, London, SW18 3SX, England
Tel: +44 81 871 2016 - Fax: +44 81 874 0449

STOP GO ARABIC تمهل

WITH CORELDRAW!® AND VENTURA® 3.0 GEM®

AL-RASSAM AL-ARABI

Is an add on to Corel Draw® that let you draw, paint, type text from arabic font libraries, apply stunning effects, output on laserprinters & imagesetters the ARABIC WAY.

ARABIC PUBLISHER

To Get High Quality Arabic DTP.

No extra training is needed. Just use Ventura Publisher® the everyday way to make Professional Documents in ARABIC or FARSI. Vowels & Accents, automatically placed to get the best position. Automatic ligature selection. Internix Latin with Arabic or Farsi. Large font libraries. Import text from popular ARABIC or FARSI word processors...

Write to: LAYOUT Ltd, 8 Atho Street, # 401 Nicosia CYPRUS.
Fax: (357) 2 448326 or (961) 9 936439, Ph: (357) 2 366484



Ventura is trademark of Ventura Software Inc. Gem is trademark of Digital Research. Corel Draw is registered trademark of Corel Systems Corp.

MORE CACHE • LESS CASH

The Most Complete Line of Add-in Memory Boards for HP-Computers



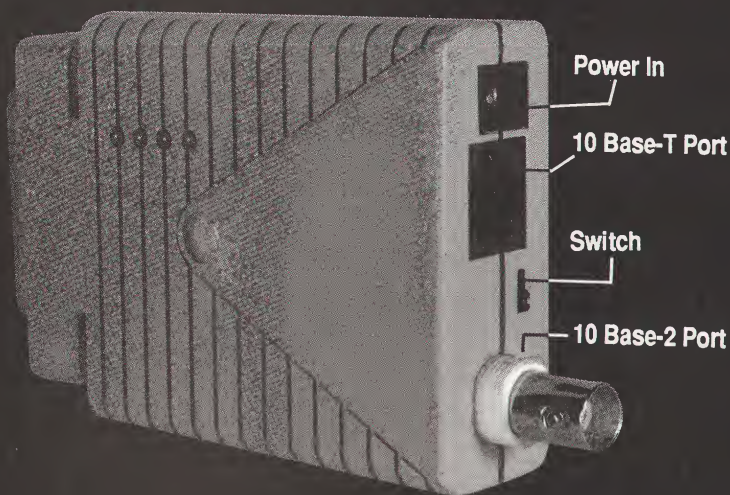
We're strong on Performance

HP 1000	A 400, A 600, A 700/1-2-4-6-8 MB
	A 900, A 990/4-8-16-32 MB
	Hood-Connectors
HP 3000	9x7/16-32-64-128 MB Extender card for 5 and 7 modules
	920, 922, 932, 948, 958/16-32 MB
	925, 935, 949/8-16 MB
	950, 955, 960, 980/16-64 MB
HP 9000	200, 300/0,5-1-2-4 MB
	318, 330/4-8 MB
	319/4-8 MB
	332/1-4 MB
	340/4 MB
	345, 375, 380/4-8-16-32 MB
	350, 370/4-12 MB
	360/4-8-12 MB
	362/1-2-4-8 MB
	382/4-8-16 MB
	400/4-8-16-32 MB
	425e/4-8-16 MB
	705, 710/8-16-32 MB
	720, 730/16-32-64 MB
	750/16-32-64-128 MB
	8x7/16-32-64-128 MB Extender card for 5 and 7 modules
	820, 822, 832, 842, 852/16-32 MB
	825, 835, 845/8-16 MB
	850, 855, 870/16-64 MB

- 10 Years Warranty
- Immediate Delivery
- Affordable Prices

GFKT HAMBURG · GERMANY
Frankenstraße 29 · 2000 Hamburg 1
Phone (40) 23 73 01-0
Fax (40) 23 17 89

TP'S DUAL-PORT POCKET ETHERNET ADAPTER



DUAL PORTS COMPACT IN A SINGLE UNIT!

10 Base-T (Twisted Pair) & 10 Base-2 (Thin) cabling scheme in same unit, selected by hardware switch

SOFTWARE COMPATIBILITY:

Novell Netware, ODI driver, LAN Manager support

FEATURES:

- LED indicator: Power, Traffic, BNC and UPT LED
- Compatible with IEEE 802.3 Ethernet Standard
- Connect via parallel port
- Memory Size: 32KB (not occupying system memory space)
- No Configuration Switch

Model No. TP-2000



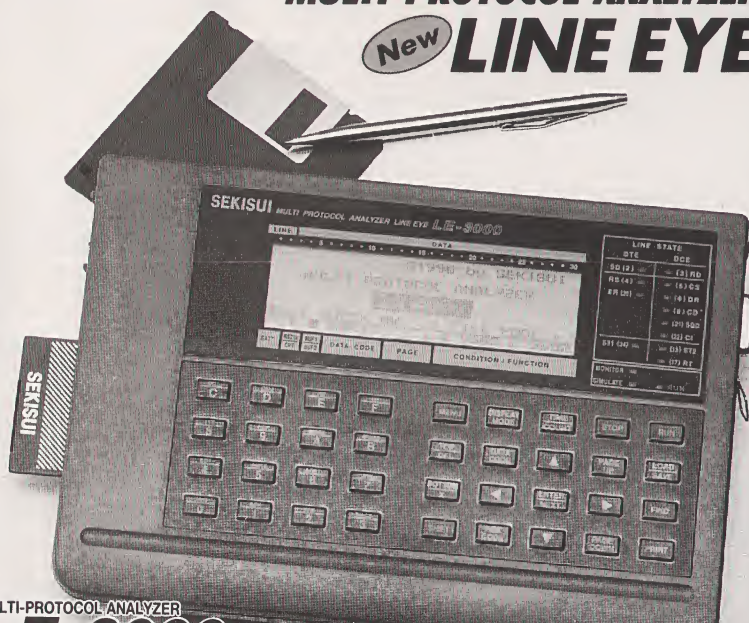
TECHPOWER CO., LTD.

20th Fl., No. 204, Sec. 5, Mingsheng E. Rd., Taipei, Taiwan, R.O.C.
Tel: (02) 753-1930 Fax: 886-2-7531940/7153105

All brand names are registered trademarks of their respective owners. The above information is subject to change without notice

SEKISUI

RS-232C MULTI-PROTOCOL ANALYZER New LINE EYE



■ LE-3000 MAJOR FUNCTIONS

- Statistical analysis • Idle time measurement
- Automatic configuration • Off-line analysis
- Data extend with 128KB/256KB S-RAM cards
- Protocol translation display capability
- Powerful trigger function • BERT function
- Timer/counter capability • 192Kbyte buffer memory

MULTI-PROTOCOL ANALYZER LE-2000

Multi-function analyzer that supports high-speed communications network of 64Kbps.

COMPACT PROTOCOL ANALYZER LE-1000

High-performance RS-232C line monitor capable of monitoring high-speed asynchronous communication of 38.4Kbps.

COMPACT LOGIC ANALYZER CA-1000 CA-500

- Simultaneous sampling of 16 channels at a rate of 100MHz.
- Large capacity memory: 32Kbits/CH
- Simultaneous sampling of 16 channels at a rate of 50MHz.
- Large capacity memory: 32Kbits/CH

SCSI ANALYZER SC/2

SC/2 has the SCSI simulation capability. A high-performance analyzer for professional use that is capable of simulating both the initiator and the target.

MULTI-PROTOCOL ANALYZER

LE-3000

Monitors high-speed communication of 72Kbps.
A high-end analyzer capable of program simulation

LE 3000/2000: Restricted by COCOM

SEKISUI CHEMICAL CO., LTD.
Computer Applied Equipment Division

4-4 Nishitemma, 2-chome, Kita-ku, Osaka, 530 Japan
PHONE: OSAKA (06) 365-4504 FAX: OSAKA (06) 365-4375
TELEX: 5236943 SEKIOS J

Up to Date. Down to Earth.



UNIX is changing the world of computers, the world of business – quite simply, changing the world. It's revolutionizing office automation. It's required for U.S. government computer contracts. It's the backbone of information strategies worldwide.

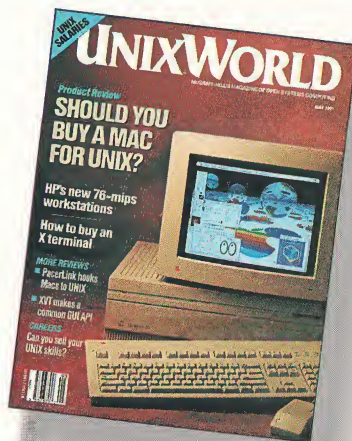
That's why you need **UNIXWORLD** – the magazine that keeps you up to date on the rapidly changing world of open systems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help your company use UNIX to its fullest. And unbiased hardware

and software reviews to help you invest wisely when you buy.

UNIXWORLD's in-depth features go beyond dry technical facts to show how the pieces fit together – to tell you what's important about the advances and strategies that are changing your world. And **UNIXWORLD** consistently offers the freshest, most down-to-earth writing that you'll find in any computer publication.

Subscribe today and receive the next 12 issues of **UNIXWORLD** for just \$18.00 – half the regular newsstand price. Save even more by ordering for two or three years. You can't lose – every subscription to **UNIXWORLD** comes with a no-risk guarantee*.

Subscribe now!
Call toll-free:
1-800-257-9402 ext. 29



If you're into UNIX, you need

UNIXWORLD

McGraw-Hill's Magazine of **OPEN SYSTEMS COMPUTING.**

***UNIXWORLD's** no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.
UNIX is a registered trademark of UNIX System Laboratories, Inc.

DH1AUW9

Listing 1: *The shift-AND algorithm for exact string matching.*

```

#define WORD_SIZE 32      /* the size of a
                           computer word */
#define MAX_SYM 256      /* the size of
                           the alphabet */
unsigned int CV[MAX_SYM]; /* the characteristic
                           vector table */
char pat[WORD_SIZE];      /* the pattern (bounded
                           by WORD_SIZE) */
unsigned int m;           /* length of the pattern */
unsigned int bit[WORD_SIZE]; /* bit[i] has a 1
                              in the ith
                              bit only */

preprocessing(pat, CV) /* compute the
                       characteristic
                       vectors */
{
    char *pat;
    unsigned int *CV;
    {
        int i, j;
        m = strlen(pat);
        for (j=0; j<WORD_SIZE; j++) bit[j] =
            (1 << (WORD_SIZE - j - 1));
        for (i=0; i<MAX_SYM; i++) {
            CV[i] = 0;
            for (j=0; j<m; j++) {
                if (pat[j] == i) CV[i] = CV[i] | bit[j];
            }
        }
    }

    shift_AND(text, textend, CV)
    char *text, *textend;
    unsigned int *CV; /* the characteristic
                       vector table */
    {

```

```

        unsigned int R;
        unsigned int S;
        unsigned int cv; /* characteristic vector
                           for current character */
        unsigned int bit_0; /* used to store bit[0] */
        unsigned int endpos; /* bit mask for testing
                              for a match */

        endpos = bit[m-1];
        R = bit_0 = bit[0]; /* initial state */
        while(text < textend) { /* main loop */
            cv = CV[*text++]; /* get characteristic
                               vector for the
                               current character */
            R = ((R >> 1) | bit_0) & cv; /* shift, fill,
                                         AND */
            /* It is possible to avoid the 1-filling by
               using 0 to indicate a match and OR
               instead of AND */
            if (R & endpos) report_a_match(text);
        }
    }
}

```

Listing 2: *The new main loop for dealing with one substitution error.*

```

R = R_save = R1 = bit_0 = bit[0];
/* R_save is needed to remember the old value of
   R; it's possible to do without it if we "double
   the loop" (see agrep's code) */
while(text < textend) {
    cv = CV[*text++];
    R = ((R >> 1) | bit_0) & cv;
    /* for exact matching */
    R1 = ((R1 >> 1) & cv) | (R_save >> 1) | bit_0;
    if (R1 & endpos) report_a_match(text);
    R_save = R;
}

```

ensures that the previous characters match.

To check for condition *b*, we simply shift column 1 downward. To quickly check condition *a*, we prepare (ahead of time, when we first see the pattern) a *characteristic vector* of size *m* for each alphabet character. The characteristic vector for character *i*, for example, has a 1 in positions 2 and 4, which are the positions in the pattern where *i* occurs, and a 0 otherwise (that is, 01010). The characteristic vector for *v* is 10100; for *d*, it is 00001; for all other characters, it is 00000.

To take care of condition *a*, we match the vector obtained by shifting column 1 downward (column 1 is 10000; after the shift, it is -1000) with the characteristic vector for *i*; only the positions with 1s in both vectors are set to 1, and all others are set to 0. This is indeed the correct value of column 2. The only exception is at position 1, in which case condition *b* is trivial (there are no previous positions). So, when we shift, we always fill the first position with a 1.

Here's another example. Column 3 is 10100. After the shift (and the 1-filling), it

is 11010. We then compare it—using an AND operation, bit by bit—to the characteristic vector for *i*, which is 01010, and we obtain 01010. Shifting and performing ANDs are usually just as fast in C as adding and subtracting, so the whole algorithm is very fast.

To summarize, we first constructed a table that shows all matches to all prefixes of the pattern. Next, we found a recurrence that computes all entries in the table. Finally, we discovered a way to compute each column in the table by essentially one shift of the previous column and one Boolean AND operation with a characteristic vector. Now we are ready to write the program. Although the algorithm is counterintuitive, the program turns out to be surprisingly short.

The program in listing 1 is not as fast as a well-tuned program based on Boyer-Moore filtering, but you can easily extend it to handle more complicated patterns. Suppose that instead of *vivid*, you are looking for all words that have five characters and an *i* in the second and fourth positions (which is how we searched the

dictionary to find *vivid* as an example). A common way to indicate this pattern is .i.i., where "." stands for any character.

The `shift_AND` program in listing 1 can handle this pattern without any modifications. The only thing we need to do is to change the preprocessing slightly. We simply add 1s in the first, third, and fifth positions to the characteristic vectors of all characters. This indicates that the first, third, and fifth positions match all characters. To exclude digits, for example, we just set their characteristic vectors to 00000.

It gets even better. We discovered that you can extend this algorithm to support approximate pattern matching in a very general way. This discovery was the basis for the development of `agrep` (although `agrep` now uses several other algorithms as well) and the ability to provide general-purpose approximate pattern matching.

Approximate String Matching

Let's try one substitution error. In our example, we want to search for all the occurrences of *vivid* with possibly one

The best data compression software.

Without exceptions.

Sure, Stacker™ and SuperStor™ compress the data on your hard drive. Except Windows™ swap files. Except QEMM Optimize™. Except Norton Utilities Speedisk™. Except, except, except.

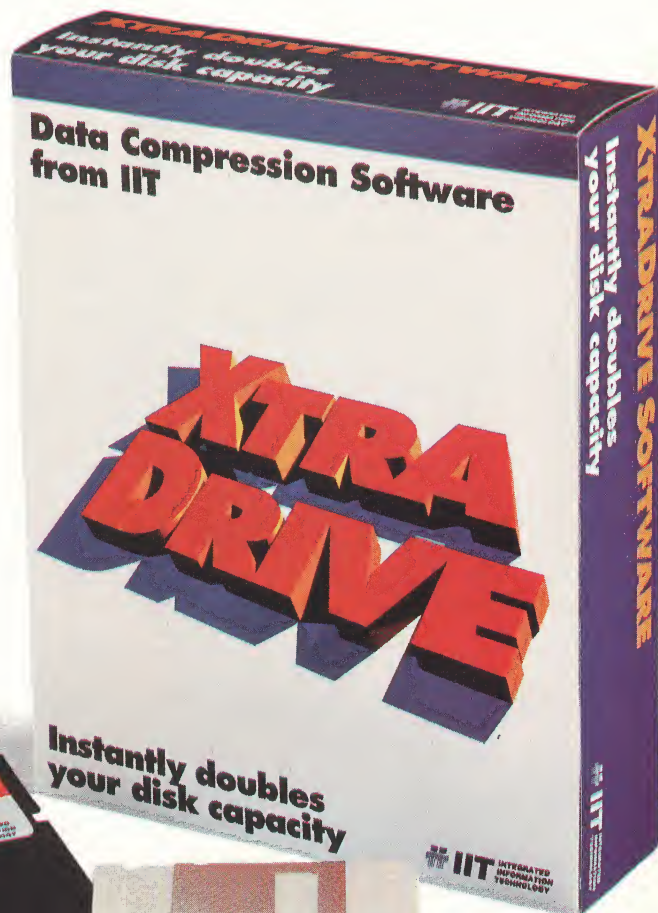
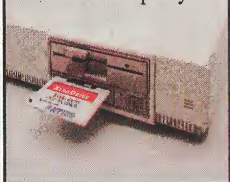
So when they claim to be the best, XTRADrive™ takes exception.

In fact, exceptions are only the beginning of the difference between XTRADrive and the competition.

They make you rewrite your CONFIG.SYS. XTRADrive doesn't. They make you write compressed files to a new drive designation. We don't.

Call (800) 832-0770 for a free data compression comparison brochure. Or check out XTRADrive at your computer dealer.

Here's what you need to know about the easiest way to double your hard drive capacity.



XTRADrive is also available as a snap-in hardware module.

What's more, only XTRADrive safeguards your data by maintaining two copies at all times during installation. And only XTRADrive de-installs as easily as it installs, with no reformatting.

So why settle for data compression with exceptions? Instead, choose the data compression that's exceptional: XTRADrive.

IIT INTEGRATED
INFORMATION
TECHNOLOGY

character changed. We compute two tables. One table, R , is identical to our previous table, and it is computed in the same way. The other table, which we denote by R^1 , is similar to the first table, except that it shows all matches that either are exact or have one substitution.

R

```
vivi&dv&vivid
v 1010001010100
i 0101000001010
v 0010000000100
i 0001000000010
d 0000000000001
```

R^1

```
vivi&dv&vivid
v 1111111111111
i 0101000101010
v 0010100010101
i 0001000001010
d 0000100000001
```

Look first at the fifth column of R^1 . This column differs from the fifth column of R in the first, third, and fifth positions. Indeed, $vivi&$ matches the pattern $vivid$ with one substitution, $vi&$ matches viv

with one substitution, and $&$ matches v (the first row of R^1 is always 1).

We can discover the match with one substitution of $vivi&$ to $vivid$ by looking at the fourth column of R and finding the exact match of $vivi$. If there is an exact match up to the last character, then there is always a match with at most one substitution (there may be an exact match, but we don't care, because R will indicate it). So one way to add 1s to R^1 is by shifting down the previous column of R without the AND.

Now look at column 10. In R^1 , column 10 is 11010. The second row is 1 because of an exact match (vi), which is covered by the shift. The fourth row corresponds to the match of $v&vi$ against $vivi$, in which the substitution occurred earlier. We can discover that match by looking at the ninth column of table R^1 , checking that there is a match (with one substitution) of $v&v$, and verifying that the last character (i) matches.

Overall, all possibilities can be handled with just two additional arithmetic operations. If the substitution is for the current text character or there is an exact match, then shifting the previous column of R will

discover the match. If the substitution occurred earlier, then shifting (with 1-filling) the previous column of R^1 and performing an AND on it with the characteristic vector will discover the match. Listing 2 shows the new main loop that checks for one substitution error.

Now we will deal with insertions and deletions. An insertion or deletion that happened earlier is already indicated by the previous column of R^1 ; it can be detected by the exact same shift and AND operation that detected an earlier substitution. An insertion at the end can be detected by copying the previous column of R (without a shift). And a deletion can be detected by shifting the current (new) column of R .

For example, the third column of an R^1 that covers substitutions, insertions, and deletions would be 11110; the fourth 1 comes from a match of $vivi$ to viv by deleting the last i , and we detect it by shifting the third column of R . The second 1 can be obtained in two ways: We can match vi to viv by inserting the last v (which we detect by copying the second column of R), or we can match vi to the v that starts in the third position by deleting



**Don't spend your time
looking for information...
Spend your time using it!!**

With ZyINDEX, you can find information contained in any document collection on network or stand alone computers in just seconds. Quick, precise, fun; ZyINDEX can search word processing, database or graphics files in plain english. Many output features. Powerful search tools: Word or Phrase; Boolean; Proximity; Synonyms and more... Powerful InfoApps features: HyperLink; Notes; Cut & Paste; Print; Launch...put your information to work for you. ZyINDEX works with WordPerfect, Word for Windows, dBase, graphics and other file formats. Developers API Toolkit available.

Call 1-800-544-6339 for
free demo or update info

ZyLAB
Division of
Information Dimensions, Inc.

100 Lexington Drive • Buffalo Grove, IL 60089
Phone: (708) 459-8000 • Fax (708) 459-8054

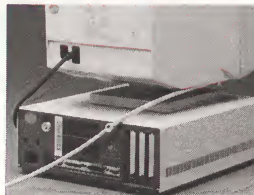


COMPUTER SECURITY PRODUCTS

COMPLETE LINE OF PROVEN AND EASY TO INSTALL
COMPUTER SECURITY PRODUCTS FOR COMPUTERS.

PREVENT COMPUTER THEFT!

Kablitz™ Security System



This system allows you to secure all your computer components: CPU, monitor, keyboard, printer. **Internal component security:** Kablitz fasteners secure the rear panel of CPU protecting internal boards and hard drives. Fasteners available for all applications. Prices \$34.95 to \$49.95 depending on system.

DISK DRIVE LOCK™

IBM PS-2 DLK-270 Series



Now you can lock a diskette into your disk drive and force the computer to boot from the diskette. Disk Drive Lock models available for PS/2 - 30, 55SX, 50, 70 and 90. Protect your data from viruses or from being copied. Other drive locks to fit most non IBM PS/2 and Macintosh disk drives. List price \$24.95

Order your free catalog of these and many other security products. Purchase orders accepted. Quantity pricing available. Shipping not included. MC/VISA accepted. Dealer inquiries invited.

Secure-It, Inc. 1-800-451-7592
18 Maple Court East Longmeadow, MA 01028

The Hottest Event At COMDEX Will Give You A Warm Feeling Inside.



The hottest ticket at COMDEX might just be the hottest ticket anywhere. This year, the Fourth Annual Micrografx Chili Cook-Off will make a city that is used to eye-popping spectacles sit up and take notice. While you're having the time of your life, you'll also be helping improve the lives of many parents and children.

For the first time ever, the computer and entertainment industries are coming together to show how the marriage of their respective technologies can benefit business, education and the general public. Some of the greatest country and rock musicians in the world are scheduled to perform a live concert.

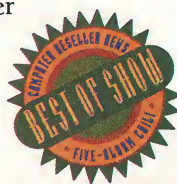


This show, produced by the Walt Tucker Group, incorporates the

newest computer technology in the industry. In fact, there is interest from several networks in broadcasting this blockbuster live.

Before the show, you'll mingle with the giants of the computer industry. Sample some world-class chili. And compete in entertaining sports such as armadillo races and the legendary Roll-O-Roper contest. Celebrities from the world of sports and entertainment will be on hand to serve up chili and sign autographs.

What makes this event twice as memorable is the fact that your money will keep working long after the last bowl of chili has been served. The proceeds of your donation go to the National Center For Missing



NCMEC has helped in the recovery of over 20,000 children.

& Exploited Children. This non-profit organization handles tens of thousands of cases and has an impressive success rate in helping to reunite missing children with their families.

The companies featured at the bottom of the page have already demonstrated their generosity through significant contributions. Now it's your turn.

Call (703) 516-6158 to order your tickets, come by booth #7062 at the Las Vegas Convention Center during COMDEX, or buy your tickets the night of the performance. Because the warm feeling you'll get by attending doesn't necessarily have anything to do with the chili being served.



the i. Overall, substitutions, insertions, and deletions can be handled with four arithmetic operations.

Furthermore, if you want to allow more than one error, it's no big deal. You simply maintain one additional table for each error and use similar transitions from one table to another. This algorithm supports arbitrary wild cards, range of characters (e.g., all digits), complements of characters (e.g., anything but blank), and a whole host of other options. In fact, you can even

extend it to search for any regular expression, even with errors.

Agrep

Motivated by this algorithm, we developed agrep for approximate or exact pattern matching in Unix. It's as fast as any other grep that we know of for exact string matching (it takes about 0.1 second of user time to search a simple string in a 1-MB file on a Sparcstation II), and it can do much more.

A typical use of agrep is to search for patterns in text files as follows:

```
agrep [ -OPTIONS ] pattern
[ -f patternfile ]
filename(s)
```

The file or files are typically scanned line by line (but not always; see below), and all lines containing the pattern are output.

Agrep has three significant features not supported by other greps. The first is the ability to search for approximate patterns. For example, `agrep -2 Krushell ideas-file` will find *Krushal*, *Kruchel*, *Krushalle*, and any other word that can be obtained from *Krushell* with at most two substitutions, insertions, deletions, or any combination of these. (This search took 1.3 seconds of user time in a 2-MB text file on a Sparcstation II.) If you don't want to, you don't have to specify the number of errors: `agrep -B breacracy /usr/dict/words` scans the dictionary for the best match to *breacracy*, which is great for someone who doesn't know (and maybe doesn't want to know) how to spell *breacracy*.

It is even possible to assign different costs to insertions, deletions, or substitutions. For example, `agrep -1 -I2 -D2 555-3217 address-file` will output all lines containing numbers that differ from 555-3217 by at most one digit. The `-I` option sets the cost of insertions (`-D` sets the cost of deletions); in this case, setting it to 2 prevents insertions and deletions.

Agrep's second advantage is that it's record-oriented rather than just line-oriented. A record is, by default, a line, but it can be user-defined; for example, `agrep -d '^From' -1 Kruschel mail-file` outputs all mail messages containing *Kruschel* with at most one error (mail messages in Unix start with *From*, and the `-d` option defines records separated by the given delimiter).

Agrep's third major advantage is that it supports Boolean queries. For example, `agrep -d 'XXXX' 'Kruschel;[8-9]/#/'92' ideas-file` outputs all *ideas* (which we assume are separated by XXXX) containing *Kruschel* and a date that starts with either 8 or 9 and ends in 92 (that meeting was about two months ago, right?). The symbol # stands for arbitrary wild cards—that is, anything, of any length, can replace it.

These options can be combined with other new options to form powerful queries. Two examples follow.

`Agrep -i -d '====' -1 '<byte>; Manbr;matching;<199[1-2]>' bib-file` outputs all records (separated by

Add Multimedia Video to your Personal Computer

Ten boards to match every need for your PC and PS/2. All run under MS Windows 3.1, MCI, MS DOS 5.0, or OS/2 2.0

- Super VideoWindows lets you display full motion video with stereo audio. Capture professional quality images in most popular file formats.
- Optional add-on's let you watch TV on your PC or merge video with VGA graphics/text.
- JPEG/MPEG options capture clips of video/audio to hard disk for playback on demand.
- Supported by leading multimedia applications and tools.

★★★★ AWARDS ★★★★★

- Readers Choice Award
MPC World
- 1992 Readers Choice Award
Presentation Products
- 1992 Top 100 Award
Windows Magazine
- Authoring Shootout-Winning Team
PC Weeks Lab
- Excellently Cool Device Award
Computer Shopper
- 1992 Best Product Award
MicroVision Annual Distribution Summit

NEW MEDIA GRAPHICS

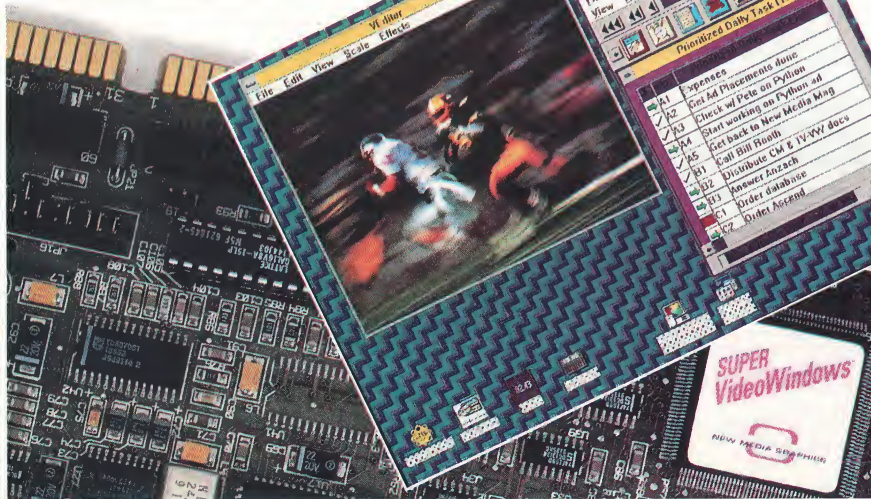
MICROSOFT®
WINDOWS™
COMPATIBLE

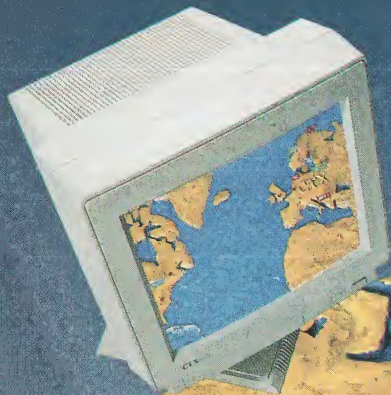
New Media Graphics Corp.

780 Boston Road, Billerica, MA 01821-5925

Tel. 508 663-0666 • Fax. 508 663-6678

1-800-288-2207





CTX: Bringing the Whole World Into View

With an extensive warehouse distribution network, and the compliance with multinational safety standards, CTX monitors are now reaching users world-wide.

For years, the full line of CTX products has been constructed for unparalleled quality with world-wide compatibilities in mind. Built with ergonomic ingenuity and trend-setting technology, now CTX SVGA and Professional Series (CPS) offer more advanced features than ever:

- **NON-INTERLACED, FLICKER FREE**

Flicker-free images at VESA non-interlaced 72 Hz refresh rate reduce eye strain and headaches.

- **HIGH RESOLUTION**

High resolutions up to 1280 x 1024 add to image sharpness and increase the amount of information on Windows.

- **FULL SCREEN DISPLAY**

The simple adjustment of external controls results in a Full Screen Display — eliminating dark margins around the image. This ability is a tremendous advantage in Graphics User Interface and Multimedia applications.

- **FLAT-SQUARE SCREEN**

CTX large screen models (CPS-1560 & 1760) are manufactured with flat-square picture tubes for CAD/CAM and imaging applications. This increases display clarity while reducing image distortion and screen glare.

**Circle 500 on Inquiry Card
(RESELLERS: 501).**

- **PROGRAMMABLE SCREEN CONTROL**

CTX Professional Series features digital controls which allow for easy adjustment of picture size and position. With 15 memory channels preset to the most common video standards, these monitors adapt quickly to a wide range of video cards. The Multiscan Series (CMS) provides up-front knobs for screen adjustment while retaining all other advanced features of CPS models.

- **LOW RADIATION (MPR II)**

Low Radiation models are available for additional protection against electromagnetic radiation emitted by all CRT's during normal use.

Model	5468A	5468NI	CPS-1460	CPS-1560	CPS-1760
Scan H:	30-38KHz	30-50KHz	30-60KHz	30-60KHz	30-65KHz
Freq. V:	50-90Hz	50-90Hz	50-90Hz	50-90Hz	50-90Hz
Resolution (Max.)	1024x768 /43.5Hz	1024x768 /60Hz	1024x768 /70Hz	1024x768 /70Hz	1280x1024 /60Hz



Where Monitors are CTXellent

For more information, or to bring a world standard monitor within your reach, call CTX today.

See us at
COMDEX/Fall '92
Booth #S4066

CTX INTERNATIONAL
20530 Earlgate Street
Walnut, CA 91789
714/595-6146
Fax 714/595-6293

CTX SOUTH
6090-F Northbelt Parkway
Norcross, GA 30071
404/729-8909
Fax 404/729-8805

CTX EAST
146 Division Place
Hackensack, NJ 07601
201/646-0707
Fax 201/646-1998

CTX MIDWEST
500 Park Blvd., Suite 425
Itasca, IL 60143
708/285-0202
Fax 708/285-0212

CTX OEM
1225 E. Crosby Rd., A21
Carrollton, TX 75006
214/416-9610
Fax 214/245-7447

Use PCT_EX Typesetting Software

Name	Definition
Gamma	$\Gamma(z) = \int_0^{\infty} t^{z-1} e^{-t} dt$
Sine	$\sin(x) = \frac{1}{2i}(e^{ix} - e^{-ix})$
Zeta	$\zeta(s) = \sum_{k=1}^{\infty} k^{-s} \quad (\Re s > 1)$

To Make Your Books, Manuals, Articles, & Math Formulas Look Their Best!

For professional publishing and the power to produce high-quality books, technical documents, mathematical formulas, and tables, rely on PCT_EX to make your work look its best. PCT_EX provides a full-function T_EX formatting system for including mathematical formulas in any kind of document. The next step beyond standard desktop publishing, PCT_EX is the difference between average and expert. And with our **PC T_EX Systems**, you get everything you need, with no extra costs.

The **PC T_EX System for Laser Printers** includes:

- PC T_EX and PC T_EX/386
- Our screen previewer and laser printer drivers
- $\mathcal{A}\mathcal{M}\mathcal{S}$ -T_EX and L^AT_EX Macro Packages
- Free Technical Support

For a free catalog and demo disk, call 415/388-8853. See the best for yourself!
Personal T_EX, Inc. • 12 Madrona Street • Mill Valley, CA • Fax: 415/388-8865

PERSONAL
T_EX
INC

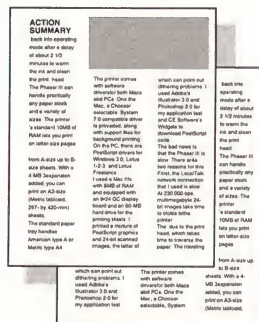
BYTE Reprints

If you would like reprints of any article in BYTE,
please contact:

Faith Kluntz
BYTE Reprint Department
One Phoenix Mill Lane
Peterborough NH 03458
Phone: 603-924-2525
Fax: 603-924-7620

for information and quantity prices.

Minimum order: 500



BYTE

SOME ASSEMBLY REQUIRED

====) referencing articles in BYTE (the -i makes it case-insensitive) in 1991 or 1992 by Manbr (or something like that—one error is allowed) and dealing with matching. The error cannot be in either BYTE or the year (the angle brackets forbid errors in the pattern between them).

Agrep -p -5 abcdefghij /usr/dict/words outputs all words in the Unix dictionary that have at least five of the first 10 letters of the alphabet in order. The -p option makes insertions free everywhere, so, for example, it can be used to give acronyms and find the full name. Since we don't pay for insertions, only deletions make sense, which is why the query has the meaning it has. The reply to this query (at least on our machine) starts with *academia* and ends with *sacriligious*. We'll tell that to Dr. Kruschel the next time we see him. ■

Editor's note: The source code for agrep is available on the Internet by anonymous ftp to cs.arizona.edu. You'll also find it on BIX in the frombyte92 listings area.

BIBLIOGRAPHY

- Aho, A. V. "Algorithms for Finding Patterns in Strings," in J. Van Leeuwen et al., *Handbook of Theoretical Computer Science*, vol. A. Cambridge, MA: MIT Press, 1990.
- Baeza-Yates, R. A., and G. H. Gonnet. "A New Approach to Text Searching," *Communications of the ACM*, October 1992.
- Gonnet, G. H., and R. A. Baeza-Yates. *Handbook of Algorithms and Data Structures*, 2d ed. Reading, MA: Addison-Wesley, 1991.
- Wu, S., "Approximate pattern matching and its applications." Ph.D. dissertation, University of Arizona, 1992.
- Wu, S., and U. Manber. "agrep—A Fast Approximate Pattern-Matching Tool," *Usenix Winter 1992 Technical Conference*, San Francisco, January 1992.
- Wu, S., and U. Manber. "Fast Text Searching Allowing Errors," *Communications of the ACM*, October 1992.

Udi Manber is a professor of computer science at the University of Arizona. He won the Presidential Young Investigator award in 1985 and is the author of *Introduction to Algorithms—A Creative Approach* (Addison-Wesley, 1989). Sun Wu is a member of the technical staff at Bell Laboratories in Murray Hill, New Jersey. Both authors won the best paper award at the 1992 Usenix Winter Technical Conference for their work on agrep. You can reach them on BIX c/o "editors" or on the Internet at udi@cs.washington.edu and sw@cs.arizona.edu, respectively.

TRAVEL LIGHT, TRAVEL NEAT, TRAVEL SMART...

ABC BICOM B260i



Germany DM2375.-

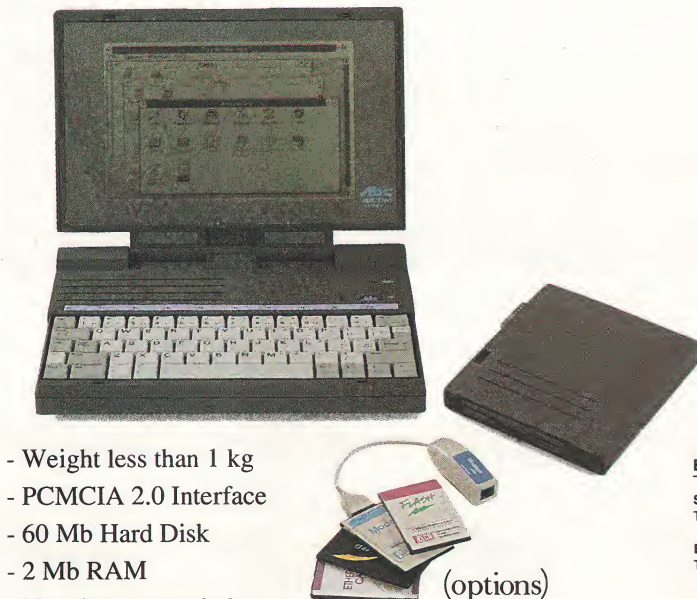
U.S.A. USD1450.-

Denmark	(DKK)8800	New Zealand	(NZD)2700
Finland	(FIN)5900	Sweden	(SEK)7700
France	(FRF)7700	U.K.	(GBP)770
Italy	(ITL)1700000		

*Except Germany all prices exclude sales tax.

ABC Computer (U.S.A.) Corp.

2531, 237th Street, Suite 122, Torrance, California 90505, U.S.A.
Tel: (310) 325-4005 Fax: (310) 325-6369



- Weight less than 1 kg
- PCMCIA 2.0 Interface
- 60 Mb Hard Disk
- 2 Mb RAM
- No adapters needed
- 128k static RAM, 256k FLASH
- Enhance AT processor (Landmark 21.5MHz)
- Uses normal AA batteries
- Advanced power management and PIM
- Full DOS and Windows compatible



(options)

England

Suntec Corporation Plc
Tel: (0372) 360606

Eagle Network Ltd.
Tel: 081-6836413

Canada

Power Industry
Tel: 403 463-3838

Denmark

Jepsen & Co. ApS
Tel: 045-74 62 73 73

Sweden

EM2-Data AB
Tel: 08-8-753 2020

PC direkt
Tel: 031-400 470

AXESS portabla datorer AB
Tel: 08-660 1910

New Zealand

A B Computer Ltd.
Tel: 04-4999000

Finland

Express Computer
Tel: (90) 135 5899

Germany

HERTIE Waren-und Kaufhaus GmbH
Tel: 069-668 13395

Horten Aktiengesellschaft
Tel: 0211-957 2418

OPCOM Datestechnik GmbH
Tel: 089-904 4049

Italy

D. Top Europe
Tel: 0445-953900

France

Gambetta Informatic
Tel: 01/43 49 33 30

Grafelec
Tel: 01/48 94 86 85



Premier Developer's Tools for DOS and Windows GUI Design

Island Systems presents a comprehensive set of GUI development tools to fit all needs and budgets. Quickly integrate a remarkable Graphical User Interface into a DOS-based application using C, Pascal or C++ (including 32 bit). Create dazzling screens with motif-like styling or easily customize to incorporate your own unique style. Background tasking capability allows your application to work in real-time. EMS support is available to automatically save your underlying graphics image when our menus pop up. Any video mode or font supported by the accompanying graphics library can be used. Mouse and keyboard are fully supported. All packages include comprehensive documentation and loads of

object-Menu™ for C++

object-Menu 2.0 is the easiest object-oriented application framework for DOS and Microsoft Windows. This means that your application can be seamlessly integrated into DOS graphics as well as Microsoft Windows. Our powerful, compact notation makes it easy to develop and maintain. Includes unlimited menu types, icons, dialog boxes, scroll bars, file chooser, spin control, combo boxes, tool bars, data entry, interactive hypertext help system, event manager, window manager and more. Fully extensible class library for easy customization. object-Menu Jr is the perfect C++ "starter" kit. Its a scaled down version of object-Menu with the same slick programming style for just \$129.

\$249 graphics-Menu
\$499 graphics-Menu Pro-Pak (incl lib source)
\$799 graphics-Menu Super Pro-Pak (all graphics)
\$129 object-Menu Jr.
\$369 object-Menu
\$898 object-Menu & source



**No Royalties
30 day guarantee**

**Free
Demo**

graphics-MENU™ for C & Pascal

graphics-Menu 4.0 is a collection of C and Pascal libraries, CASE tools and utilities to customize a professional GUI for your application. Built-in interface elements include windows, icons, menus, multi-column checked and scrolled lists, buttons, text edit window, file chooser, data entry forms & more. CASE tools provide an on-screen WYSIWYG design environment with complete automatic code generation for the target compiler.



Specify variant (except Super Pro-Pak):

- Native:
 - BGI
 - MS graphics
- External:
 - MetaWindow
 - Genus GX

Compilers:
Borland C/C++, Microsoft C/C++,
Turbo Pascal², MetaWare C++¹
Zortech C++¹
Graphics: BGI, Microsoft graphics,
MetaWindow, Genus GX, HALO¹
¹ object-Menu only ² graphics-Menu only

**Free
Demo**



7 Mountain Rd, Burlington MA 01803 USA
Tel: (617)273-0421 Fax (617)270-4437 BBS (617)270-9552

Circle 402 on Inquiry Card (RESELLERS: 403).



Secure your connection!

The Discovery 9632AM Modem and 9632AX Faxmodem generate faster and more reliable connections. Password security prevents unauthorized access. Call-back security provides a call-back function to the particular caller after verifying the incoming call.

- MNP5 and CCITT V.42bis support for error-free transmission throughput up to 57,600bps
- Bell 103/212A, CCITT V21, V22, V22bis, V23, V32bis, V42 and V.42bis compatible
- BTX / Minitel / Videotex / Prestel
- Connection password
- Call-back security
- VAR password
- Remote access with password
- Auto-recovery link
- User-definable function, speed selection and Talk/Data switches in front panel operation.
- Send and receive fax option

Specialized in data communication products since 1984, Datatronics provide the most complete line of full featured modems and fax modems for your desktop, laptop and notebook computers to comply with your various demands.

2921S-2 B Y T E • NOVEMBER 1992



Discovery 9632AM

Discovery 2400CM

Discovery 2496CX

Discovery 2400AM

Discovery 2496AX

Discovery 2496VX

Discovery 2496HX

Discovery 2400HM

Discovery 2400VM

Discovery 2496PX

Discovery 2496QX

Discovery 2400PM



Datatronics Technology, inc.

15 Lane 768, Pa-Teh Rd. Sec.4, Taipei 10565 Taiwan

Tel: (02)782-0002 Fax: 886-2-782-0305 Telex: 28440 DTXMODEM

Circle 388 on Inquiry Card (RESELLERS: 389).



Your Direct

BYTE introduces Your Direct Link – An enhanced service for BYTE readers that gives you free information on products – faster and easier!

In the NEW Direct Link section, here's what you'll find:

Alphabetical Index to Advertisers Including Phone Numbers

Now dial companies directly.



Product Category Index to Advertisers

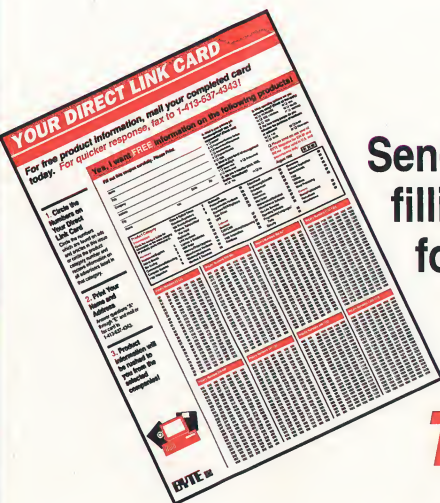
Order information on individual products or complete product categories.

Redesigned Editorial Index

Free information from companies covered in articles, columns, or news stories.

New Enhanced Direct Link Card

Receive free information quickly by filling out and mailing or faxing Your Direct Link Card today!



Send for FREE product information by filling out Your Direct Link Card found in the back of every issue.

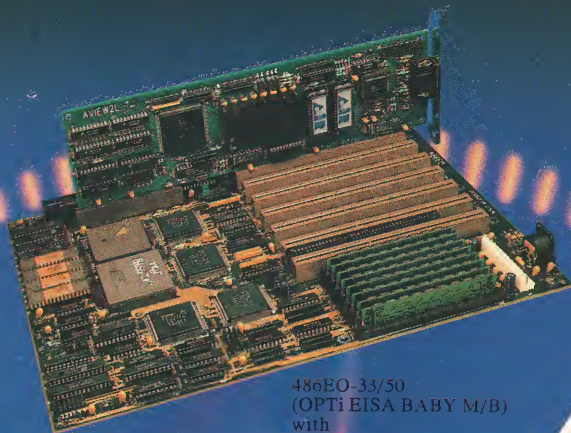
Buy It Through BYTE!

BYTE 

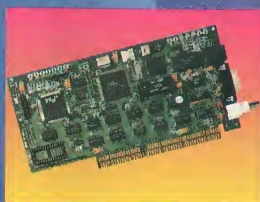
Link to Products

EISA + Local Bus: A New Level of Performance

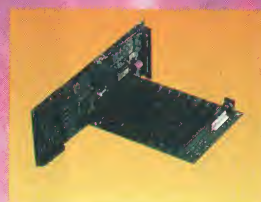
AIR : THE EISA PIONEER SINCE APRIL 1990



486EO-33/50
(OPTi EISA BABY M/B)
with
AVIEW-2L
(Local Bus S₁ VGA Accelerator)



EISA ETHERNET CARD
A-NET E1



486 BP-33/50
(486 ISA CPU card)
* IDE, FDC, 2S+1P on Board
* support Local Bus VGA
with B P-9
(Back Plane slot Board)



EISA SCSI-E1
(EISA Intelligent SCSI-II)

An ordinary computer company can be many things, but at AIR, we believe that to be the leader, we have to be first, fast, and should constantly offer a new degree of performance. AIR was one of the first with an EISA mainboard as early as April 1990, when others were still wondering what it stood for. Today, we offer you the latest in EISA technology. The AIR 486 EO-33/50 is an EISA baby-sized Mainboard that's small in size but max on features and expansion options, and supports one Local Bus slot. Our AIR SCSI-E1 is a 32-bit intelligent SCSI host adaptor that confirms to the SCSI-II protocol, with a 10Mb/s data transfer rate, and a 16Mb/s (33 Mb/s in burst mode) bus transfer rate. Our EISA Ethernet cards confirms to the NE3200 architecture for excellent performance / cost ratio due to a high-performance system architecture and a dual-chip solution, making it ideal for workstation and file server applications. Our Avview 1L & 2L VGA cards utilizes our Mainboard's 32-bit Local Bus VGA that enhances the performance of the regular displays from the standard I/O bus for a new level of video performance.

The AIR name is now recognized the world over for advanced products that carry with its quality and reliability. Our boards are the workhorses behind many leading international PC brands. Not many can claim to a reputation that has been recognized by the industry's most respected publications: BYTE & PC Magazine.

New products release:

1. Full series ISA/EISA with 3 X Local Bus slot.
2. Industrial 486 ISA CPU card series.
* Support Local Bus *
3. S₁ ISA/EISA/Local Bus VGA with 16M colors and 928/805/801 chip set.



Manufacturer & Exporter
UNITED HITECH CORPORATION
7F-1, No. 1 Wuchuan 1 Rd.,
Hsinchung City, Taipei-hsien, Taiwan, R.O.C.
Tel: 886-2-299-3125/30 Fax: 886-2-299-3210

In the U.S., please contact:
ADVANCED INTEGRATION RESEARCH, INC.
2188 DEL FRANCO STREET SAN JOSE, CA 95131
Tel: (408) 428-0800 Fax: (408) 428-0950

Distributors
GERMANY:
STUTTGART:
NP COMPUTER SYSTEME GmbH
Tel: (49) 0711-629010 Fax: (49) 0711-6210030

U.K.:
GETIN
Tel: (44) 0923-233737/239705
Fax: (44) 0923-250139

FINLAND:
MICRODATA OY
Tel: 358-0-4582211
Fax: 358-0-4582020

SPAIN BARCELONA:
BX SISTEMES
Tel: (34) 93-5820208
Fax: (34) 93-5820209

COMDEX / Fall '92

16-21 November, 1992
Las Vegas, Nevada, U.S.A.
SAND Convention
#S2894

A CALL TO ARM



Apple's decision to use the U.K.-designed ARM610 CPU chip in its Newton PDA (Personal Digital Assistant)—and in future PDAs—may have come as a surprise to many people. Before Apple's announcement (see "The PC Gets More Personal," July BYTE), Advanced RISC Machines' ARM architecture was not at all well known in the U.S.

What's the attraction of the ARM610? This 32-bit RISC CPU combines fast processor speed and low power consumption in a small package. For hand-held systems such as Apple's Newton, this is an ideal combination.

The basic ARM design has been around longer than any other commercial RISC processor. I first wrote about it in the January 1986 BYTE (see "The Acorn RISC Machine"). At that time, ARM stood for Acorn RISC Machine, a computer from U.K. PC manufacturer Acorn Computers. Acorn designed the original ARM in 1983 (see the text box "Origins of the ARM" on page 296). Then in 1989, Olivetti bought Acorn, and in 1991 it spun off all ARM development into ARM, Ltd., a research, design, and marketing venture jointly owned by Olivetti, VLSI Technology, and Apple Computer. ARM's chips are manufactured under license by VLSI Technology in the U.S. and by GEC Plessey in the U.K.

An ARM6 Overview

ARM's commercial strategy is to design custom ASICs (application-specific ICs) based on the ARM6, a macro-cell implementation of the original ARM CPU architec-

ture with 32-bit addressing. A macro cell is the VLSI CAD equivalent of a subroutine; it's a complete predesigned (and debugged) circuit element that you can drop into a new design without modification.

The ARM6 is so simple that its CMOS implementation uses only about 33,500 transistors and occupies very little silicon area when compared to rival CPU designs; Intel's 486 requires 1,200,000 transistors. The ARM CPU element consumes less than one-quarter of a small silicon die, leaving room for other components that a customer chooses for specific jobs. For example, in the embedded controller market, a customer might specify some on-chip ROM to hold the control software, and a UART (universal asynchronous receiver/transmitter) for serial communications.

The ARM610 is one such specific ASIC design, intended especially for advanced hand-held, battery-powered computers. In addition to an ARM6 CPU core, the ARM610 contains a 4-KB instruction and data cache, a write buffer, and an innovative MMU (memory management unit) that's optimized for the needs of an object-oriented operating system (see figure 1). The instruction set is small, as you'd expect of a RISC design, and all instructions are conditionally executed (see the text box "The ARM610 Instruction Set" on page 297).

Although the ARM610 is a custom design for Apple,

Here's why Apple and other companies are jumping on the ARM bandwagon

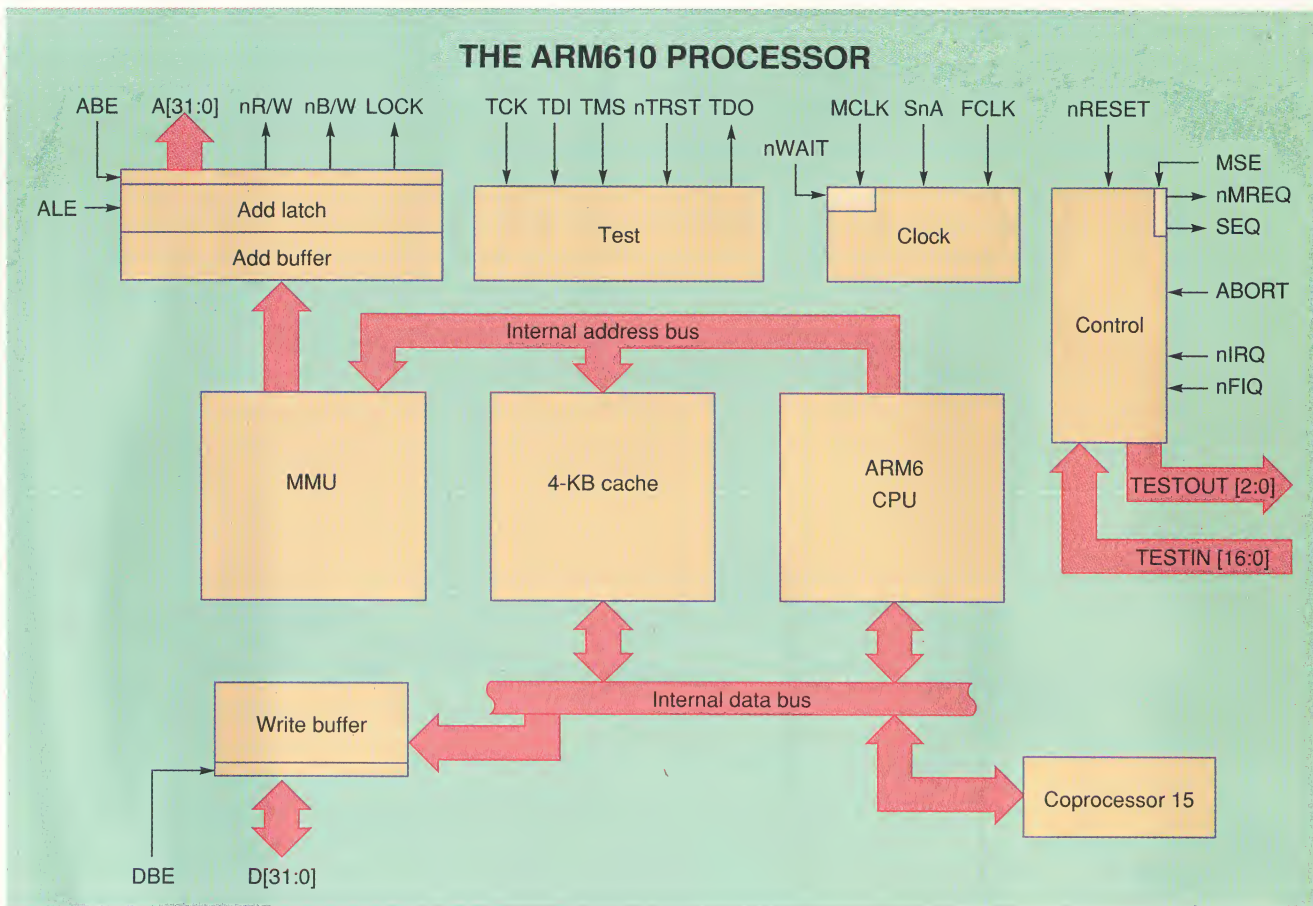


Figure 1: The ARM610 RISC CPU contains a 4-KB instruction and data cache, a write buffer, and an innovative MMU that's optimized for the needs of an object-oriented operating system.

which holds a patent on the MMU, any computer company can buy the chip. The fact that a small U.K. company succeeded in supplying Apple's needs under the noses of the U.S. semiconductor giants is due at least in part to the development speed that the macro-cell approach offers: ARM started delivering silicon to Apple just four months after receiving the specification.

When you're designing a hand-held, battery-operated computer, raw speed is not the sole CPU performance criterion. Pen-based computers running handwriting-recognition software need plenty of processing power, but power consumption and physical package size are more important. The ARM CPU, capable of 20 to 25 MIPS, isn't a performance leader when compared to newer RISC designs like Sun's SuperSparc, the Mips R4000, and DEC's Alpha, but it offers the best combination of speed, size, and power consumption for hand-held systems.

The ARM610 yields a speed-to-power ratio of about 0.35 MIPS per milliamper, five times better than the SparcLite's and 10 times better than the Motorola 68030's.

The ARM610 is thrifty because it's implemented as a fully static CMOS device; you can stop and restart the system clock at any point in the instruction cycle with no loss of state information. Other low-power designs, like Intel's 386SL, are fussier about when you stop the clock, and they require extra logic to restart safely. The ARM610 also contains other tricks to minimize power usage—especially by the potentially power-hungry cache and MMU.

Good manufacturing yields, a consequence of its small (22-mm) die size, make the ARM610 competitive in dollars per MIPS as well. The ARM610 comes in a 144-pin plastic surface-mount thin-quad flat package, which is the size of a postage stamp and only 1.4 mm thick. In order to squeeze the 22-mm-square die into this tiny package, the manufacturers grind down the backs of the finished silicon wafers to a thickness of less than a millimeter before cutting them up.

Core Architecture

The ARM610's CPU core is a 32-bit microprocessor of classic RISC design, with

full 32-bit data and address buses (see "RISC Basics," April 1991 BYTE, page 298). All ARM instructions are 32 bits long, are decoded directly by hard-wired control logic, and use no microcode. The CPU has only 10 types of instructions, most of which execute in a single cycle. It has a three-stage execution pipeline, so one instruction can execute while the CPU decodes its successor and fetches a third from memory.

ARM's pipeline is shallow and simple compared to recent radical designs such as the Mips R4000 and DEC's Alpha; there are no instructions that manipulate pipeline sequencing explicitly. As a result, the ARM610 cannot equal those processors for sheer burst speed, but it's straightforward to program in assembly language (you don't have to worry about complex pipeline dependencies) and presents an easy target for compiler writers.

ARM's 32-bit data path contains a 32-bit hardware multiplier and, as an unusual touch, a barrel shifter that is closely coupled to the ALU. Most ARM arithmetic and logic instructions contain a bit field

that can specify a shift of their second operand register so that you can combine, say, an add and a shift (or a rotate) into one instruction. The CPU uses the barrel shifter internally to align data and to extract bytes from whole words during byte-addressing operations.

As is usual for a RISC processor, the ARM610 employs a load/store architecture where data-processing operations take place only between register contents; they never take place directly between a register and memory (or between memory and memory). The ARM610 has 37 32-bit registers, of which 31 are general-purpose data registers and six are status registers (see figure 2).

However, only 16 of these data registers (R0 through R15) and only two of the status registers are ever visible to the programmer and to user programs. Of these, register R15 is reserved as the program counter. The other 15 data registers, called *banked* registers, get switched in whenever any sort of exception is processed for the ARM610's own internal use. In this way, the ARM610 preserves the contents of the user registers without writing them to an external memory stack. This is how the ARM610 gets its quick response to interrupts, exceptions, and context switches, which makes it a suitable processor for real-time systems.

The ARM610 processor operates in six different modes that can be switched by software or by external hardware signals. *User* and *supervisor* modes are for normal program and protected operating-system use. *FIQ* (fast interrupt request) and *IRQ* (interrupt request) modes are for interrupt handling. FIQ mode has a minimum interrupt latency of just four processor cycles and a worst case of 26 cycles, which is less than 5 microseconds in a 25-MHz system. *Abort* mode is for handling address exceptions from the MMU in virtual memory systems. The ARM610 enters *undefined* mode whenever an undefined instruction is executed. It uses this mode to trap coprocessor instructions issued when the required coprocessor is not present and to vector out to a suitable software-emulation routine.

The ARM6 core is basically an integer CPU with no floating-point hardware, but it has an on-chip coprocessor interface that it can use to access up to 16 external coprocessors. Three of the 10 ARM6 instruction types are reserved for coprocessor instructions, so off-chip functions look completely consistent with internal functions from the programmer's view.

The ARM610 design ignores this external coprocessor interface (i.e., it's not brought out to the chip's pins), so you can't

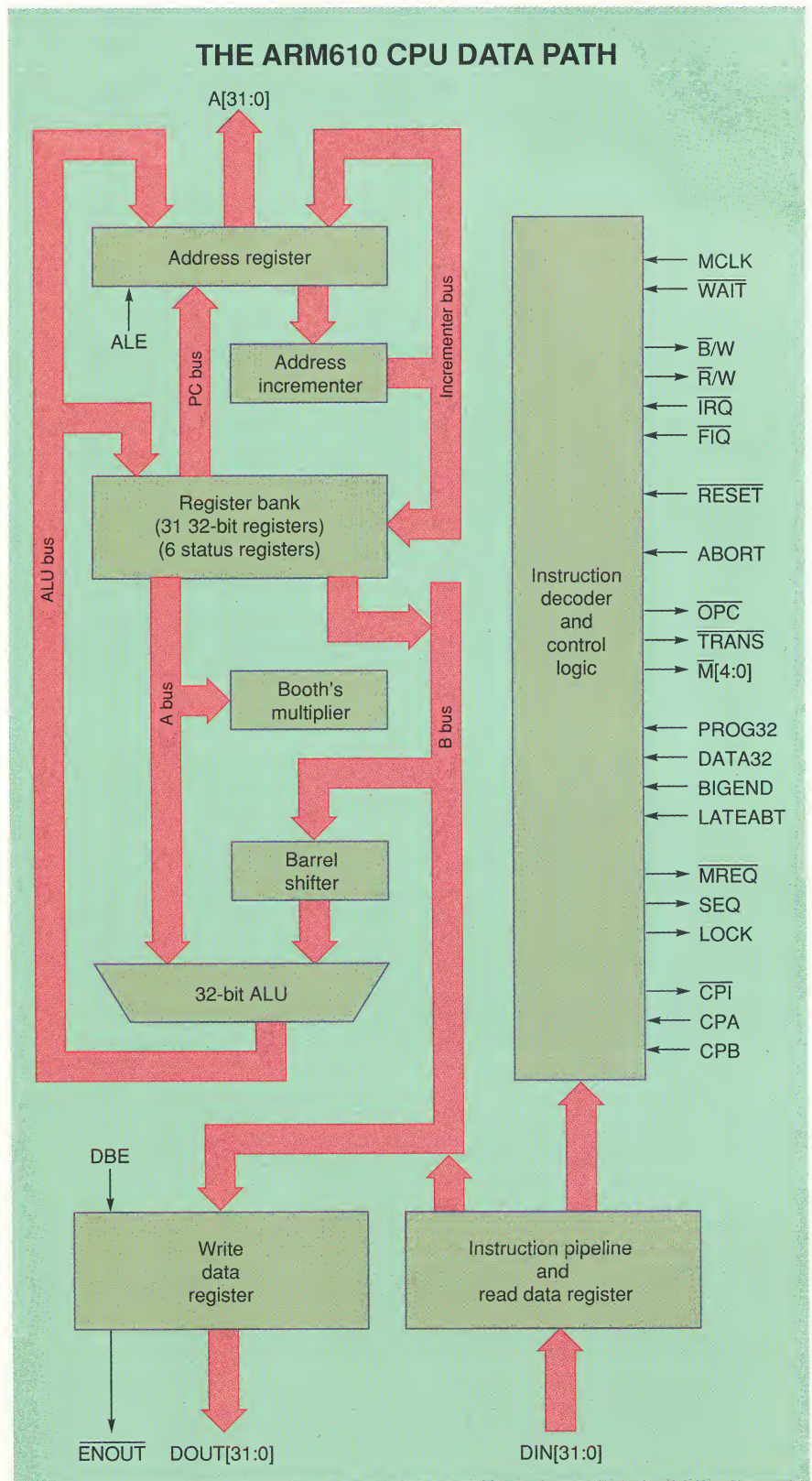


Figure 2: Of the ARM's 37 32-bit registers, only 16 data registers and two status registers are visible to the programmer. The other data registers get switched in whenever any exception is processed for the ARM's internal use.

Origins of the ARM

Acorn, designer of the ARM (Advanced RISC machine) architecture, was founded in 1979 by Chris Curry and Herman Hauser, both of whom had previously worked with Sir Clive Sinclair, inventor of the legendary Sinclair Research ZX80. The firm shot to success by winning a BBC design competition for an advanced personal computer to accompany an educational TV series. The BBC Computer (which users nicknamed the "Beeb") used Motorola's 8-bit 6502 processor. The Beeb was advanced for its time; it had higher-resolution color graphics than the Apple II and a fast (2-MHz) processor.

By 1983, Acorn was looking for a successor to the 8-bit 6502, which had

reached an evolutionary dead end. Acorn's designers were unimpressed by Motorola's 68000 and Intel's 8086. The BBC system software depended heavily on the excellent interrupt response of the 6502, and adopting the comparatively sluggish 68000 would have meant adding lots of DMA and other hardware complications. Instead, Acorn bravely—some say foolishly—designed its own CPU, the true heir to the 6502. A 32-bit CPU, the ARM CPU skipped a whole generation. Acorn based the design on the then-new RISC ideas pioneered at Berkeley.

Acorn appointed Steve Furber (who is now ICL Professor of Computer Engineering at Manchester University) chief architect, and VLSI Technology

the silicon foundry. Using VLSI's CAD software, Furber's Cambridge team laid out the ARM—their first CPU project—in 18 months using software simulation rather than hardware prototypes. It worked from first silicon, clearly vindicating the RISC philosophy.

Acorn's third-generation chip, the ARM3, still powers the Archimedes PC, which is widely used in British schools. The ARM3 introduced a two-speed caching scheme that predates Intel's DX2 clock-doubling technology by several years. VLSI Technology's version of the ARM CPU, sold as an embedded controller, found its way into the Radius Graphics Accelerator for the Macintosh, thereby bringing the chip to Apple's attention.

add an FPU. However, it does implement coprocessor 15 on-chip and uses it to control the ARM610's various subunits, including the cache, write buffer, and MMU. You must therefore use coprocessor instructions to perform operations like flushing the cache or enabling address translation. One such control instruction switches the ARM610 chip between big-endian and little-endian byte ordering, and another switches between 32-bit and 26-bit addressing for compatibility with older ARM software (the earlier ARM1, ARM2, and ARM3 had only 26-bit address buses).

The ARM610 is a fast CPU designed to work with slow, inexpensive DRAM memory systems; therefore, it contains an on-chip cache. This 4-KB mixed data and instruction cache holds 256 lines of four words (16 bytes) each, organized as four blocks of 64 lines (64-way set-associative). This extraordinarily high degree of associativity entails very complex checking logic when compared to, say, the Intel 486's 8-KB four-way cache. But it greatly improves the hit rate, which otherwise would be poor in such a small cache. Such logic is hard to design, but it makes for a smaller and less power-hungry chip than would simply adding more cache RAM.

In another power-saving move, ARM turned off the cache RAM's sense amplifiers on the ARM610 for all accesses except the first one during sequential memory accesses. (Modern fast RAM cells use

analog sense amps to second-guess digital voltage transitions before they are stabilized, but they consume a lot of power.)

The ARM610 uses a write-through cache. Rather than writing directly to memory, it writes to a write buffer that can hold up to eight words and two separate addresses. The buffer then completes the write to memory in its own time, allowing the CPU core to execute the next instruction without pause. This further insulates the CPU from low-speed RAM. Up to two write operations can be pending in the buffer, and one of these writes can be a sequential transfer of seven words to consecutive addresses. The MMU controls both the write buffer and the cache, so it must be enabled to use them.

The MMU

The most radical aspect of the ARM610 is its MMU, which combines a sophisticated conventional virtual memory controller with a novel scheme for partitioning memory along object-oriented lines. This aspect of the chip's design is the subject of a patent held by Apple Computer and licensed to ARM.

Virtual memory is the use of secondary storage (typically a hard disk) to extend the amount of available RAM by transparently swapping blocks between disk and memory. Instead of accessing physical RAM locations directly, all application programs work through virtual addresses.

The virtual address space is much larger (often measuring gigabytes) than the actual amount of RAM present, and it is divided into units, called *pages*, that get swapped between disk and memory. The MMU keeps in memory a set of tables that map the virtual page addresses into physical RAM locations.

When a program tries to access an object whose virtual address falls in a page that's not in memory, the MMU raises a special kind of exception called a *page fault*. The CPU traps this fault and then jumps into an operating-system routine called the *virtual memory manager*, which swaps in the required page (and in so doing may swap out another page to make room). The MMU then updates its page tables, the suspended task restarts, and the memory access succeeds as the MMU translates the virtual address into a real memory address.

The ARM610 MMU maps both virtual addresses and memory-access rights. Every address is protected by permissions, in much the same way as files are protected under Unix. When a task attempts access, there are two considerations: whether the address is actually in RAM, and whether the requester has permission to access it. Attempting to access an address without permission results in a *permission fault* exception. The novelty of the MMU is that it maps virtual memory and permissions as separate, orthogonal concepts.

The ARM610 Instruction Set

The ARM610's instruction set is small and regular, as you would expect from a true RISC processor. The most unusual fact about ARM (Advanced RISC machine) instructions is that they are all conditionally executed. The 4 most significant bits (28 through 31) of every instruction code form a condition field that is compared with the contents of the N, Z, C, and V flags in the PSR (program status register) before execution. Only if this test succeeds will the CPU execute the instruction.

Unexecuted instructions don't cause an abort, but instead proceed through the pipeline, acting like a NOP (no operation). Conditional instructions let you avoid writing explicit branch instructions in many cases, and since a skipped instruction is less costly than the pipeline break caused by a branch, this greatly improves the processor's throughput. RISC processors with deeper pipelines, like the Sun SuperSparc and Mips R4000, have adopted more complex schemes such as "delayed branch with annulment on branch not taken." This approach may be faster, but it lacks the elegant simplicity of the ARM scheme.

There are 10 main ARM instruction types that are encoded in a 32-bit word. Each of these types can be modified by the 16 possible condition-field values; in the ARM assembly language, this is symbolized by appending the two-letter condition name as a suffix to the main mnemonic. Thus, ADDEQ would be "add if Z flag is set," and MOVHI would be "move if C is set and Z is clear." The first two instruction types perform data processing. The first breaks down into 16 integer addition, subtraction, and logic instructions, while the second comprises the hardware multiply instructions.

The next three instruction types are the data transfer instructions, which load and store register contents to main memory. These comprise the single register transfers (LDR and STR); the single data swap (SWP), which exchanges the contents of a register with a memory location; and the block data transfers (LDM and STM).

The ARM610 supports only base relative addressing (and PC relative addressing if you choose R15 as the base register), but it has tricks to achieve more complex modes. The U, P, and W bits in the instruction code deter-

mine whether to add or subtract the offset to the base register, either before or after the transfer and with or without writing back the modified base address. Thus, you have the effect of pre- or post-indexed automatic incrementing and decrementing. The block transfers can load or save any subset of the currently visible registers.

There are just two branch instructions—branch and branch with link (B and BL)—but, again, these can take 16 conditional forms. Branch with link saves the old contents of the program counter into register R14 of the current bank.

The last three main instruction types are the coprocessor instructions, which comprise data transfers between coprocessor and main memory (LDC and STC), register transfers between the ARM610 and the coprocessor (MRC and MCR), and coprocessor internal operations (CDP). Another special instruction, software interrupt (SWI), forces the CPU into supervisor mode. You can use it to call operating-system routines. The ARM610 ignores the 24-bit operand field of this instruction, but it's useful for passing information to the supervisor routines.

In truly object-oriented systems, objects are protected entities; only those tasks that are *methods* of the class of which an object is an instance can legally access its data. Enforcing this protection in software is a slow process, since it requires that all data be accessed indirectly via a class table. The ARM610 supports this protection efficiently in hardware. By combining address and permission mapping, the chip can divide the virtual address space into a fine-grained, protected object store.

Three major components of an object-oriented operating system can benefit from this hardware support. The virtual memory manager uses address mapping to control disk swapping. A *persistent object store* uses both address and permission mapping to bring objects transparently into memory when they are referenced. And a concurrent garbage collector can use permission mapping to deny all programs access to the region of memory that it is

currently "sweeping."

Persistent object storage erases the distinction between the concepts of "in memory" and "on disk" from the user's viewpoint. There are no files—just a catalog of objects that you can activate without knowing their storage location. Any system that uses dynamically created objects needs a garbage collector to stop the memory from clogging up with redundant objects.

Current systems use garbage collectors that periodically take over the whole machine. This behavior is responsible for that noticeable pause familiar to any Smalltalk or Lisp programmer. The ARM610 MMU lets you implement an efficient *concurrent* garbage collector as a permanent background task. Any other task can call upon the garbage collector, which protects each page of the task's memory in turn, copies any live objects (i.e., ones that have valid pointers) into an active page, and disposes of all other objects.

Put more formally, the ARM610 MMU maps permissions via the concept of *domains*, 16 contiguous and disjoint regions of virtual memory that are distinct from pages. All tasks run in an *environment* consisting of a set of permission maps for one or more domains. The environment is said to be a client of these domains. An environment might have a different permission map for each domain of which it's a client, but all clients of a domain share the same virtual address mapping.

An object-oriented operating system assigns a software manager to each domain, and these managers dole out permissions to application tasks. Object-oriented programming systems map their classes onto domains, using the MMU to protect each object's integrity.

Virtual Memory

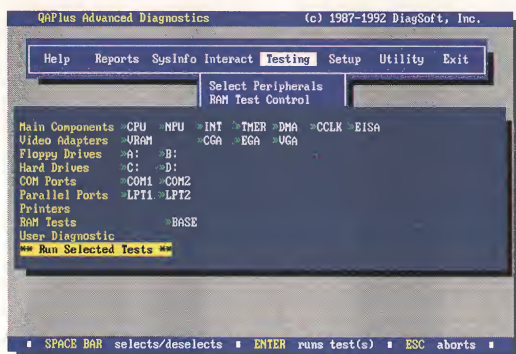
The ARM610's MMU keeps its translation tables in physical memory, but the

PC Diagnostics and System Information

Come see us at Fall Comdex - Hilton, booth #8706

QAPlus™ Over 2 MILLION users

- ☐ Even novices can quickly solve common computer problems
- ☐ Review hardware configuration and performance benchmarks
- ☐ Now includes LAN features for network PC support and management



Also from DiagSoft: *QAPlus/WIN™* for tuning and troubleshooting Windows® and *QAPlus/FE™* for power-users and service/support professionals.

DiagSoft, Inc., 5615 Scotts Valley Drive, Suite 140, Scotts Valley, California 95066 • 1-800-DIAGSOFT • 1-408-438-8247.
Suggested Retail: \$159.95 • Call for the dealer nearest you.

UNDER THE HOOD

table entries are cached in an on-chip TLB (translation look-aside buffer) that has room for 32 addresses. The virtual address space can be mapped either in 1-MB sections, which require only a one-level table lookup, or in pages, which need a second lookup level. The MMU supports small (4-KB) or large (64-KB) pages. Large pages allow single table entries to map large data objects. This helps to keep the translation tables small.

When the CPU requests a memory access, the MMU's access-control logic first looks in the TLB for a translation of the virtual address. If it's there, the access-control logic checks to see whether the access is permitted. If so, the MMU outputs the physical address immediately. If the TLB misses, then the MMU computes an index into the external translation table, which is offset from an address held in the on-chip translation-table base register.

If this translation-table entry is for a section, it will contain the actual base address of the section. This is combined with an index contained in the virtual address to give the physical address. If the translation-table entry is for a page, then it contains the base address of another table, the *page table*, and a second lookup is required to get the physical address. In both cases, the MMU checks permission before the access proceeds, and it updates the TLB by overwriting the existing entry with the resulting physical address.

A Compact CPU

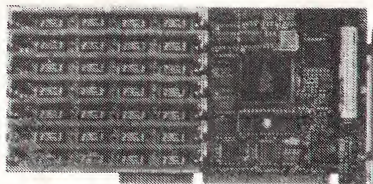
If the Sun SuperSparc and the DEC Alpha were top-fuel dragsters, the ARM610 would be a European sports car. It's small and economical, but it still outperforms popular PC CPUs like the 486 and 68030. And its MMU contains the key to the next generation of system software.

Although ARM isn't yet a mainstream architecture in the U.S., Apple will benefit from its many available language compilers and programming tools. That would not have been the case if Apple had used a totally new processor in the Newton. Also, ARM's lack of mainstream status is unimportant, because few people will want to port old PC or Mac software to such a radically different computer.

Newton created one of those rare conceptual breaks in computer evolution that opens up a brief window of time in which a new, more suitable processor can be adopted, free from compatibility constraints. I'm glad Apple had the courage to grasp the opportunity. ■

Dick Pountain is a BYTE consulting editor based in London. You can reach him on BIX as "dickp."

ROMDISK™



High Performance Multimegabyte Disk Emulators

NEW MODELS / LOWER PRICES

- Floppy Drive and multimegabyte emulators for ISA bus computers
- 180K to 14 MB capacities
- EPROM, Flash or SRAM technologies
- Autobooting, Single or Dual disk emulation under PC or MS DOS
- List prices from \$195

CURTIS, INC.

418 West County Road D • St. Paul, MN 55112

612/631-9512 FAX 612/631-9508

PC DOS is a trademark of IBM; MS DOS is a trademark of Microsoft

BASH, THE BOURNE AGAIN SHELL

A free Korn-shell replacement from the Free Software Foundation

Ever since AT&T's Korn shell (developed by David Korn) appeared, the Unix community has been looking for a freely distributed version of this excellent shell. The Free Software Foundation's BASH (the Bourne Again Shell) fulfills that requirement. A Unix shell is the program that interprets user commands and script programs—essentially, it's the user interface. Prior to the Korn shell (and now BASH), the two most popular Unix command interpreters were the Bourne shell (i.e., `/bin/sh`, the old AT&T standard) and the Berkeley C shell (i.e., `/bin/csh`).

The features that the commercial Korn shell and the free BASH both offer are fast performance; functions and command-line aliases; tilde expansion to home directory paths; many set options for configuration, control, and debugging complex scripts; a dynamic shell variable that keeps track of the working directory; and an easy-to-edit command history—while maintaining the basic syntax of the standard Bourne shell. BASH includes the best features of the Berkeley C shell, including job control and an embedded arithmetic interpreter.

One feature that makes the Korn shell so popular is the command-line editor, which BASH includes. As with the VMS command interpreter, you can scroll through previous commands, edit them, and issue the edited version. Unix shell command editors can look like either `vi` or `emacs`, depending on your preference. With the appropriate commands, you can use all the line-editing operations you're used to, including cut and paste.

The most obvious difference between the Korn shell and BASH (besides the license) is in the command-history expansion syntax. The Korn shell uses the syntax `r command-abbreviation`, where `command-abbreviation` can be a command number or the first few characters of a recently issued command. The Korn shell's `r` is actually an alias for `fc -s`, the Korn shell's fix-command program.

BASH, on the other hand, uses a syntax

that is nearly identical to that of the Berkeley C shell, a "bang" character followed immediately by an abbreviation. The only difficulty with using the bang character for history is in issuing E-mail and UUCP commands, which use bangs to separate network address elements. To prevent the shell from interpreting the bang as a history command, you have to preface it with a backslash, as in `uunet\!bytepb\!ben`.

BASH has been ported to a huge list of machines. It is professionally supported by a team of programmers that can be reached at `bash-maintainers@ai.mit.edu`. Brian Fox is the primary author.

The source code for BASH (BASH.SRC) is available on BIX as well as on a great number of anonymous FTP sites. BYTE is now posting the source code for Software Corner and Some Assembly Required on the UUNET system, under the directory path `/published/byte`. UUNET is the most connected computer in the world. By placing our files on UUNET, we are making them available to 11 million computer users. For more information about UUNET, send E-mail to `info@uunet.uu.net` or retrieve the file `uunet:/published/byte/README`. ■

MAC/Tom Thompson

Viewing JPEGs with JPEGView

JPEG is an up-and-coming standard for compressing image data. That's good, because JPEG can trim the size of large 24-bit images, thus conserving hard disk space. But it's bad if a JPEG-encoded file lands on your Mac and you don't have an application that understands this format. Enter Aaron Giles's JPEGView 1.1, a freeware utility that lets you view almost any flavor of JPEG file on the Mac.

JPEGView can read PICT images, JPEG-encoded PICT images (courtesy of QuickTime's compressor/decompressor software), and JFIF (JPEG File Interchange Format) files. JPEGView works reliably, too. I've used it to read JPEG-encoded images produced by Adobe Photoshop. You can then save the image in standard PICT format for use in your graphics application. If you think your work with graphics might involve JPEG-encoded files, keep JPEGView handy.

DOS & WINDOWS/Steve Apiki

Easy-Open Windows Files

Opening and reopening Windows application files can be tedious, especially if the data files for a single application live in many different directories. Open Axxess 1.4 (i.e., `Axxess104.exe`) is a \$10 shareware utility by Steven Gutz and Randy Westman that remembers the last few filenames, file types, and directories that you've accessed, sparing you the trouble of navigating the same directory tree access after access.

Open Axxess takes advantage of the Windows 3.1 Common Dialogs. When you launch Open Axxess, it hooks into the common File Open dialog box. Thereafter, any time you choose File/Open from an application that uses Common Dialogs, you get a dialog box with its control menu augmented by several Open Axxess menu choices. The menu choices let you instantly choose from among the last few files, types, and directories you've opened. You can also specify a list of permanent files.

Editor's note: Software Corner highlights public domain, freeware, and shareware programs. The programs are available in electronic formats. See "Program Listings" on page 5 for details. We solicit your contributions. We pay \$50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

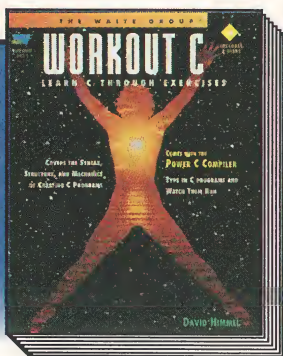
Struggling With Microsoft® or Borland® C? Shape Up With Our Easy 3 Step Solution

For a Limited Time

\$49.95

(\$30.00 Off List Price!)

1



START WITH THE WAITE GROUP'S NEW WORKOUT C.

This balanced training program covers all topics and concepts of C programming, from simple to complex. Throughout more than 800 pages of illuminating text, hundreds of hands-on exercises illustrate everything from arrays to unions and bit fields.

Workout C includes special versions of our Power C compiler and split-screen text editor, so you can compile and execute the example programs at the press of a key. There is no substitute for practice, and you get plenty of it with useful and interesting programs such as a calculator, card playing game, file dumping utility, and animated graphics.

By the time you finish Workout C, you'll have a very solid foundation on which to build a successful C programming career.

2



AFTER PUMPING UP WITH WORKOUT C, YOU'LL BE READY TO DO SOME HEAVY DUTY PROGRAMMING WITH POWER C.

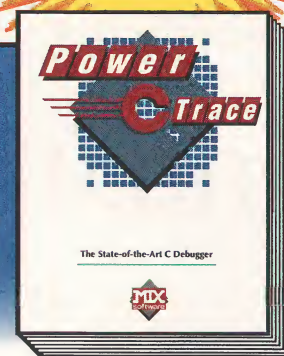
This ANSI standard C compiler is now used by over 100,000 programmers worldwide. PC magazine calls it "a heavy-weight contender at a bantam-weight price," and Power C is a three time winner of Computer Shopper's Best Buy award.

Even though it's powerful, Power C is very easy to use. That's why The Waite Group chose it over all other compilers for Workout C. And unlike some compilers that hog 30 or 40 megabytes of disk space, Power C requires only 1 megabyte.

FEATURES INCLUDE:

- ☒ Over 450 Library Functions
- ☒ Small, Medium, & Large Models
- ☒ Mixed model with near/far/huge
- ☒ Supports 8088/286/386/486
- ☒ Supports 8087/287/387
- ☒ CGA, EGA, VGA, Hercules Graphics
- ☒ 650 page manual

3



AS YOU DEVELOP YOUR OWN C APPLICATIONS, POWER CTRACE PLAYS A CRUCIAL ROLE IN THE PROCESS.

This state-of-the-art debugger helps find your programming errors fast. Describing Power Ctrace in a word, Computer Shopper simply calls it "magnificent."

No other debugger shows you the internal working of your program the way Power Ctrace does. Watch your C source code executing not just line by line, but statement by statement. While viewing source code in one window, simultaneously view variable values and program output in other windows. Break and watch points stop execution at suspected trouble spots.

Like Power C, Power Ctrace is very simple to use. Combined with Workout C, this trio of products will end your struggles and put you in great C programming shape.

Order Now and Save \$30 Off List Price

☐ Please Send FREE Brochures

Disk Size: ☐ 5.25" ☐ 3.5"

(Requires DOS 2.0 or higher)

Name

Company

Street

City

State Zip

Country

Telephone

☐ Workout Pack **\$49.95**

Includes: ☒ Workout C

☒ Power C

☒ Power Ctrace

Shipping & Handling

(\$5 USA, \$10 Canada, \$40 Foreign)

Sales Tax (Texas Only) **\$4.53**

Total Amount of Order

Paying By: ☐ Check or Money Order

☐ Visa ☐ MC ☐ Amex ☐ Discover

Card#

Exp. Date

B

60 DAY MONEY-BACK GUARANTEE

To Order Please Call:

1-800-333-0330

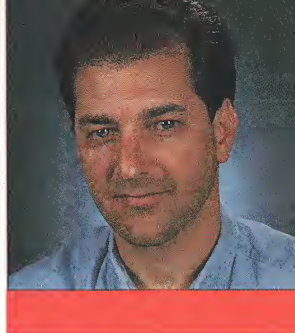
For Technical Questions:

Tel: 1-214-783-6001

Fax: 1-214-783-1404



Mix Software
1132 Commerce Dr.
Richardson, TX
75081



BRUCE D.
SCHATZMAN

AN OBJECTIVE WAY TO COMPUTE

Externally, Windows NT looks like Windows 3.1. But internally, Windows NT is as similar to Windows 3.1 as CP/M is to VAX/VMS. It took Microsoft over three years to design and build NT. Why? What is so different? The answer lies not so much in describing preemptive multitasking or symmetric multiprocessing, but in the overall system model itself.

Windows NT is different because every component is woven from the same material into a smooth, consistent fabric. While earlier versions of Windows resemble a patchwork quilt of components, Windows NT is more like a long, continuous piece of cloth.

The new operating system gets its smooth uniformity from a design that is completely object-based. Virtually everything in the operating system is defined as an object, and an important component of NT, called the object manager, is dedicated solely to overseeing the creation, usage, and destruction of these objects.

The Object Rationale

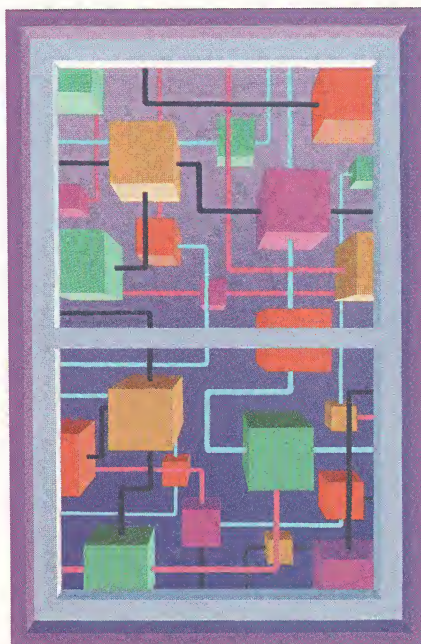
Windows NT is among the first of a new generation of operating systems that use an object-based model. Most operating-system manufacturers are switching to this model to leverage the advantages offered by OOP (object-oriented programming). OOP lets programmers think in terms that more closely model the real world. Instead of writing procedures that manipulate data as a separate entity, OOP lets you define objects of different types that combine attributes (i.e., data) and behavior (i.e., procedures) into a single package.

OOP also allows a more natural way of achieving abstraction, which lets programmers deal with higher-level components without having to deal much with the lower levels of the system. Thus, objects can be treated like "black boxes"—the manufacturer (in this case, the programmer) of the black box simply describes what it can do and how to use it.

Besides the greater power available to programmers, basing everything on objects usually leads to a simpler and more elegant design. If everything is defined as an object, you can manage all system elements in a single, consistent manner rather than using a different mechanism for each type of element. This makes the system much easier to modify or extend.

Note, however, that Windows NT is not a *true* object-oriented operating system. Most of it is written in C, not C++. Some of the advantages of C++ (e.g., inheritance and polymorphism) were therefore not available to the NT designers. But contrary to popular belief, C++ or any other OOP language is not a prerequisite for achieving an object-based design. Pen-

An object-based system model sets Windows NT apart from its predecessor



Point appears to the user (and programmer) to be object-oriented in every respect, but it too is written mostly in C. Thus, I use the term *object-based* instead of *object-oriented*, which is a stricter definition.

NT Objects Defined

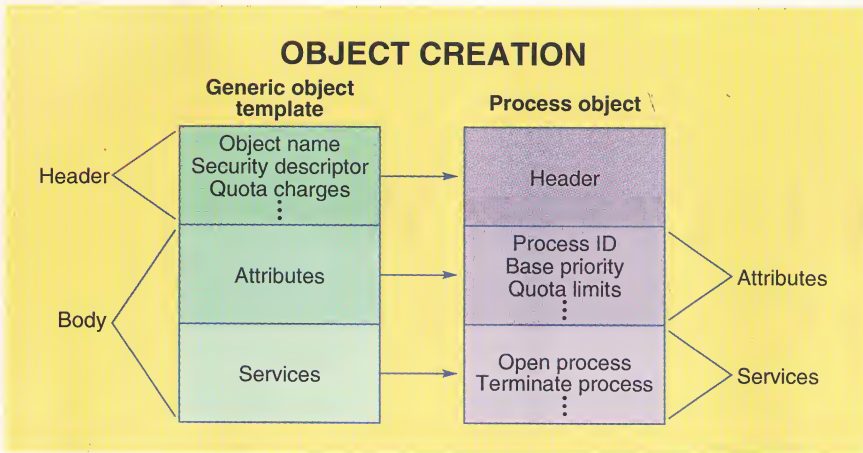
Virtually everything handled by Windows NT is an object. Files, processes, threads, RAM sections, drivers, and devices are all examples of objects. All NT objects follow a generic template that is divided into two parts: header and body. An object header contains fields of data such as the object's name, a security descriptor, and its temporary or permanent status. The body contains a set of data values (or attributes) that are relevant to the type of object and a set of functions (or services) that operate on that particular object.

All objects have the same kind of information in their header, but the body is specific to each type of object. Thus, a process object has different attributes and services than a file object, but both have the same header structure. For example, a file object has a *size* attribute and a *write* service, neither of which is relevant to a process object. Likewise, a process object has attributes and services that would not be used by a file object. The figure illustrates the generic object template and a specific object type (i.e., a process) that follows the template.

The primary benefit of having a standard object template is the ability to handle a wide range of system elements in a consistent manner. For example, all objects in the system have a *quota-charges* attribute that records the resource cost of using that object. Thus, a resource accounting program that monitors system resource usage can be built easily because there is no reason to write different code to handle each type of system element differently.

The Object Manager

Because objects are such a pervasive part of the Windows NT operating system, it



Windows NT creates specific new objects from a generic object template. Here, the created object is a process.

makes sense to have a software module dedicated solely to the management of objects. The NT object manager performs this role. The object manager provides a set of basic object management services to processes that want to manipulate objects. These basic services include object creation, location, and destruction.

However, the object manager oversees only the lowest common denominator of object operations; it is not responsible for performing object-specific operations because it knows nothing about the internal structure of an object or what it might be used for. For example, if a thread tries to write to a file, the object manager becomes involved in security considerations (an operation common to all objects); but when data must actually be written to the file, the object manager calls upon the I/O subsystem to perform the operation.

Every manipulation of an object must pass through the object manager at one level or another, and this has many desirable consequences, especially in the area of security. A central idea behind Windows NT security is to create a gate through which every use of system resources must pass. Because every resource is an object, the object manager becomes this gate.

The Key to Security

Security is a perfect way to illustrate the benefits of NT's object-based operating-system model. In many operating systems, the security system consists of some loosely associated modules, each of which is responsible for a certain type of resource (e.g., files, memory, or processes). Although this works, there are disadvantages to the design. The primary downside is complexity. It is difficult for system programmers to implement different security systems for different system resources,

and adding new security systems for new resources is not straightforward.

In contrast, Windows NT offers a centralized security system that works hand in hand with the object manager to provide a uniform security system for virtually all system resources. Because all resources are represented by objects, and all objects have a well-defined format, the security system acts upon resource objects in a consistent manner. The result is a much cleaner design that is easily extensible when new object types are introduced.

When a user logs onto an NT system, the user's credentials (i.e., ID and password) are authenticated by the LSA (local security authority) process. Note that *log-on* now means local log-on to an NT workstation on your desktop as well as remote log-on to an NT server across a network. Thus, the operating system now secures both the desktop and all network servers, instead of just network servers.

If the LSA finds the user's credentials in the server's encrypted security database, NT creates a user process and permanently attaches it to an object known as an access token. An access token is like a security pass that is checked when the user's process tries to access a system resource.

On the other side of the equation, all system resources (i.e., objects) have a security descriptor, which states the access rights to that resource. The security system therefore compares access tokens to security descriptors to approve or deny access. For example, when a user process tries to open a file for write access, the object manager sends the process's access token to the security system, which checks the file's security descriptor to see if the privileges in the access token are sufficient to write to the file.

Each security descriptor contains, as its

main component, an ACL (access control list), which is a list of users and privileges that apply to that object. An object's ACL can be modified only by the owner of the object. Thus, access to resources is completely at the discretion of the resource owner and is applicable to any system resource, providing an extremely fine level of security granularity. If desired, ACLs can specify groups of users or all users, which makes resource access easier to set up and administer.

The Programmer's Perspective

Although objects are an important part of NT, most Windows programmers will never see them directly. This is because virtually all programming for the Windows NT operating system is done through the Win32 subsystem, which provides a 32-bit superset of the Windows 3.x APIs. An application running on Win32 doesn't need to know that it is running on NT at all, and you don't need to know anything about NT objects to write applications for NT.

However, programmers creating system-oriented programs such as backup utilities or desktop extensions need to access objects directly. In this case, objects are handled much like files are handled in traditional programming. Programmers can easily deal with objects because they are already familiar with manipulating files.

If Windows NT looks like Windows 3.1 to the user, was it worth the effort to build such a sophisticated object model? The answer is most definitely yes. In addition to the benefits I've outlined, the existence of an object-based infrastructure indicates that Windows NT was designed to be the foundation of future operating environments that Microsoft will deliver.

Although the object model is completely internal and not visible to the user, expect future versions of Windows to externalize an object model in the user interface. This externalized object model will probably use Windows NT object services for infrastructure and include major extensions for object management through OLE 2.0 and other object services. When this happens, computing will change dramatically, and users will interact with computers in a completely natural manner. ■

ACKNOWLEDGMENT

Thanks to Helen Custer, author of *Inside Windows NT* (Microsoft Press, 1992), for providing much of the reference material for this article.

Bruce D. Schatzman is an independent systems consultant in Bellevue, Washington. You can reach him on BIX c/o "editors."

ASK BYTE

Lean, Mean Windows

Is there a run-time version of Windows that I can use to run a low-end Windows desktop publishing package in standard mode without dealing with the intricacies of Windows itself? If not, which Windows program files do I need to absolutely run this software in standard mode?

Charles Izevbigie
Tallahassee, FL

Some vendors included a run-time version of Windows with their applications before the advent of Windows 3.0. Unfortunately, run-time versions are no longer available.

The Windows 3.1 installation program lets you load the minimum files required to run in standard mode. The minimum configuration requires between 5 and 6 MB of disk space. If you want to pare Windows down even more, use the Windows Setup Option menu to remove nonessential files from your Windows subdirectory. Target the READ.ME, .BMP, and .WAV files; accessory applications; games; and screen-saver files. If you decide you need a file again, simply repeat the process to add it back into your Windows subdirectory.

—Stan Wszola

Tracks and Sectors

Is there a reason why I shouldn't format a 3½-inch high-density floppy disk to 720 KB in a 1.44-MB drive using the Format command's /f:720 or /s:9 switches? Why can't I use Diskcopy to duplicate a 720-KB floppy disk to a new, unformatted 1.44-MB floppy disk?

Christopher Bedford
Lansdowne, CP, South Africa

It's physically possible to format a 1.44-MB floppy disk to 720 KB, but I wouldn't do it. There are differences in the magnetic media for the various types of densities, and the head current to write to the different media varies proportionately. A 1.44-MB disk requires higher write currents than a 720-KB disk. Your 1.44-MB/720-KB drive will switch to the lower write current when you format to 720 KB. Using the lower write current on a disk that requires the higher one will make your disk unreliable. This same reasoning applies in reverse: You cannot reliably format a 720-KB disk to 1.44 MB (and you should never use those disk hole punchers that let you do so).

As for your Diskcopy question, the answer becomes obvious when you consider the sector differences. All the 3½-inch disk formats use 80-track sectors, but a 720-KB floppy disk has nine sectors per track, while a 1.44-MB floppy disk uses 18 (a 2.88-MB floppy disk uses 36). If you try to run Diskcopy, the program doesn't know which 720 KB of the 1.44-MB disk you want to use. The reverse situation is more obvious, because it's physically impossible to cram 1.44 MB of data onto a 720-KB disk. Diskcopy will simply read the two disks and refuse to copy unless they're identical.—Stan Wszola



CP/M Conversion Artist

Iwant to move my WordStar book manuscripts from a Morrow Designs MD-3 CP/M system to a 386 machine and convert them for use with Microsoft Word for Windows. Are there any programs that can read WordStar files on CP/M floppy disks? Is there a service that will convert them? Unfortunately, I don't have OCR (optical character recognition) hardware and software to

read the printed pages.

Wayne Irwin
Northridge, CA

Media Master from Intersecting Concepts (30851 Agoura Rd., Suite 200, Agoura Hills, CA 91301, (818) 879-0086; fax (818) 879-0623) is a universal disk-conversion program that reads about 200 foreign disk formats, including the 40-track MD-3 disks. To use it, run the software, insert the CP/M disk, and simply copy the files to your 386 hard drive. Once the files are on your new machine, Word for Windows should be able to convert them from WordStar format.

Media Master has one drawback: It hasn't been updated for DOS 5.0. Under DOS 5.0, your 80-track, 1.2-MB floppy drive won't be able to read the 40-track format. If you run DOS 5.0, you'll need to get a 360-KB floppy drive or boot up from a DOS 3.x or 4.x boot floppy disk.

—Howard Eglowstein

Video Control

Ihave a Sony camcorder with the Control-L port that Tom Yager mentioned in his article "Practical Desktop Video, Part 2: Raw Material" (May BYTE). I want to build an editing controller for my camera, but my dealer doesn't have access to any documentation for this port. Where can I get it?

David Annett
Upper Hutt, New Zealand

Sony publishes the Control-L specification in a document called "Protocol of Control-L," publication #997245311. In the U.S., it's available from Sony Publications (P.O. Box 20407, Kansas City, MO 64195, (816) 891-7550 ext. 33). The U.S. office isn't equipped to send copies overseas, so you should ask your local dealer to order it for you, or have a friend in the U.S. order a copy and mail it to you.—Howard Eglowstein

BYTE on UUNET

For years, BYTE has offered electronic copies of each month's featured programs through BIX. Now we're also posting these files on UUNET. If you have access to any machine on the Internet, you can retrieve files from UUNET for free. The most common method for retrieving files is to use FTP utilities. A version of FTP exists for nearly every popular operating system today. Here's what to do.

Subscription Problems?



We want to help!

If you have a problem with your BYTE subscription, write us with details. We'll do our best to set it right. But we **must** have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.

BYTE

Subscriber Service
P.O. Box 555
Hightstown, NJ 08520



ASK BYTE

Once you're on the Internet, type `ftp uunet.uu.net`. FTP should respond with

```
Connected to uunet.uu.net
220 uunet.uu.net FTP server (Version 4.1
      8/1/ 8/1/91) ready
```

followed by

```
Name (uunet.uu.net:ben):
```

Enter your user account name or press the Return key to use the default. At the `ftp>` prompt, type `help` to see a list of all the commands. Commands can be abbreviated.

Go to the BYTE files by changing your working directory to the top of the BYTE file tree (i.e., `cd/published/byte`) and list the files. The file lines that begin with `d` represent subdirectories with files that pertain to the issue date indicated. Here's a sample session:

```
ftp> dir
drwxr-xr-x 7 cas0005  other  112 Aug 16
      13:45 oct92
drwxr-xr-x 8 cas0005  other  134 Sep 12
      13:02 nov92
226 Transfer complete.
ftp> cd nov92
250 CWD command successful.
ftp> dir
-rw-r-r-7 cas0005  other  12999 Aug 16
      13:45 bash.tar.Z
-rw-r-r-8 cas0005  other  45231 Sep 12
      13:02 whisk.Z
226 Transfer complete.
```

To retrieve `whisk.Z`, enter

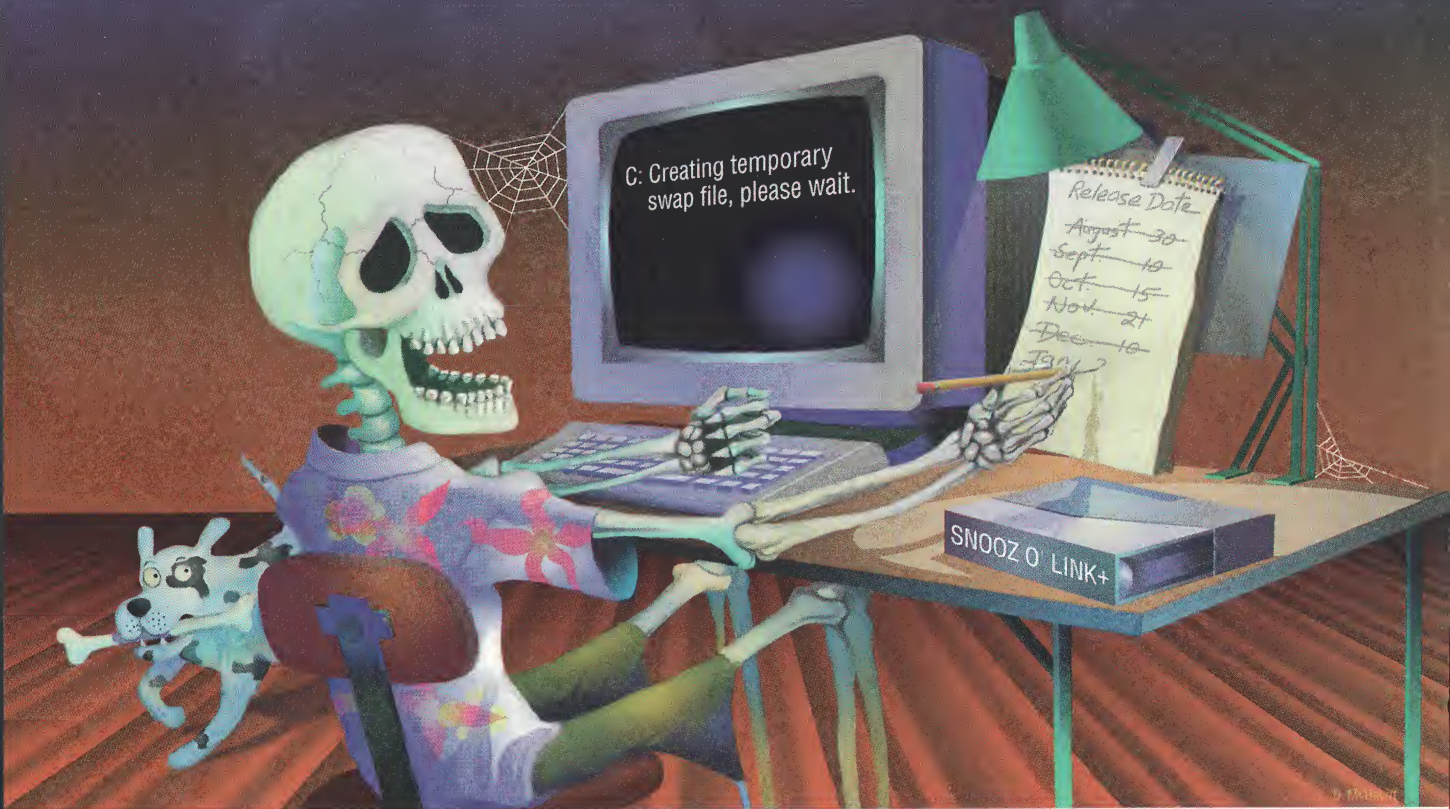
```
get whisk.Z
local: whisk.Z remote: whisk.Z
200 PORT command successful.
150 Opening BINARY mode data connection
    for whisk.Z (45231 bytes).
226 Transfer complete.
45231 bytes received in 21.74 seconds
    (2.03 Kbytes/s)
ftp> quit
221 Goodbye.
```

If you want to use filename globbing to retrieve more than one file, use FTP's `mget` command. FTP has many other options that speed up multifile transfers.

This file-retrieval process is equally as simple from Singapore as it is from the University of California. We look forward to seeing more international readers accessing the software that we publish in BYTE.—Ben Smith ■

The BYTE Lab welcomes your questions. Address correspondence to Ask BYTE, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send BIX mail c/o "editors."

We read every letter, but due to the volume of mail received, we cannot guarantee a response. We edit all letters for clarity and brevity. Letters appear in BYTE about four months after we receive them.



How much longer can you afford to wait?

Create Overlaid Programs-Fast.

BLINKER™, the world's first and fastest dynamic overlay linker, reduces your link time to seconds and reduces program memory requirements. Now you can use one linker for all your software projects.

One Linker, Many Languages.

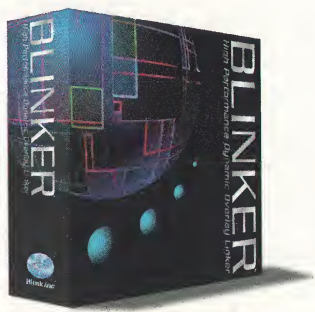
BLINKER 2.0 links and automatically overlays DOS programs written in Microsoft® C, BASIC, Assembler, QuickBASIC™, Fortran, Pascal, Watcom™ C, Zortech® C++, Clipper®, FORCE® and in Borland® C, C++, Assembler, and more.

Save Time and Memory.

BLINKER removes the need for overlay structures, simplifies program design and reduces memory requirements to save you time, effort and memory.

Memory Swap Function.

BLINKER is the ONLY linker to offer an integrated memory swap function, so you can run other large programs from within your program, with negligible memory overhead.



BLINKER™
High Performance Dynamic Overlay Linker

Don't Settle for Less.

Other major features include full CodeView® support, use of EMS/XMS at program run time, and enhanced execution speed of overlaid code.

Time is Money.

BLINKER offers all this in a fraction of the time it takes to link with your current overlay linker. You know time is money, and link time is no exception.

Free Demo

To try our free demo on your own code



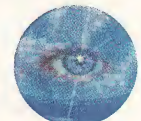
Call: 804-355-4444 or
FAX: 804-355-1676

Order now!

If you can't wait any longer, we offer a risk free 30 day money back guarantee. Available in 5.25" or 3.5" diskette format.

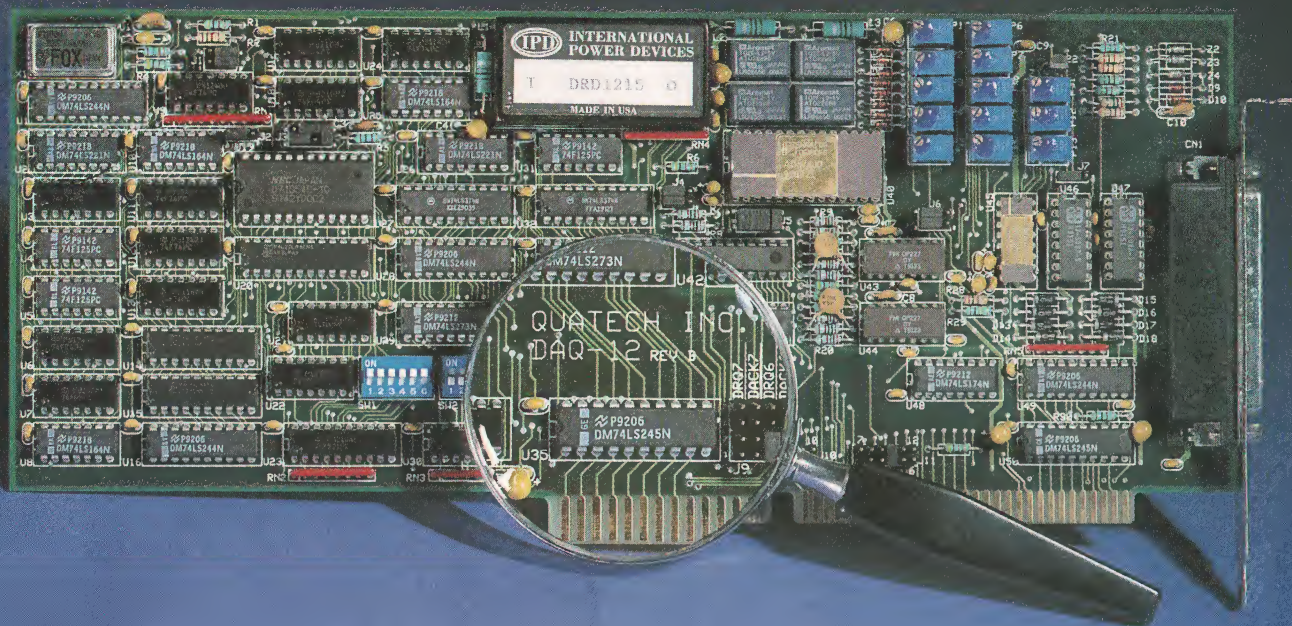
Price \$299

plus shipping & handling



Blinkinc
P.O. Box 7154
Richmond VA
23221

If your board doesn't say Quatech Inc., you may be missing something...



Ask a Quatech sales Engineer to show you
the value of quality, service and support.

- Quatech manufactures a complete line of data acquisition, communication, and Micro Channel boards for the PC AT/XT, PS/2 and compatible computers.
- Quatech's user friendly software drivers enable our full featured adapters to support most popular operating systems.
- Quatech's adapters are backed by our free on-line technical support.



For a free catalog call: **800-553-1170**

International: Australia/Interworld Electronics 03-563-7066, Canada (Western)/Interworld VCR 604-984-4171 (Toronto office 416-513-7027), England/Diamond Point International 634-722-390, Finland/Lab Hitech OY 358-0-804-2522, France/Elexo 33-1-69302880, Germany/Jupiter Electronic Systems 06181/75041, Israel/RCM Ltd. 972-03-5447885, Italy/N.C.S. Computer Italia 0331/770-016, Netherlands/ACAL Auriema 040-816565, Korea/Sam Boo Enterprise Co. 82-2-538-4001, Spain SANTA Barbara SA 34-3-203-9916, Singapore Bliss Services Pte Ltd (65) 338-1300. IBM PC-XT, AT, PS/2 and MicroChannel are registered trademarks of IBM Corp.



662 Wolf Ledges Parkway
Akron, Ohio 44311 U.S.A.
216-434-3154

Please see us at Fall COMDEX in Las Vegas, booth #4677 at Sands Expo.

Buy it Through **BYTE**

BUYER'S GUIDE

Mail Order

The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

308

Hardware/Software Showcase

This categorized four-color display section makes it easy to find Hardware and Software products from a wide variety of manufacturers and suppliers.

349

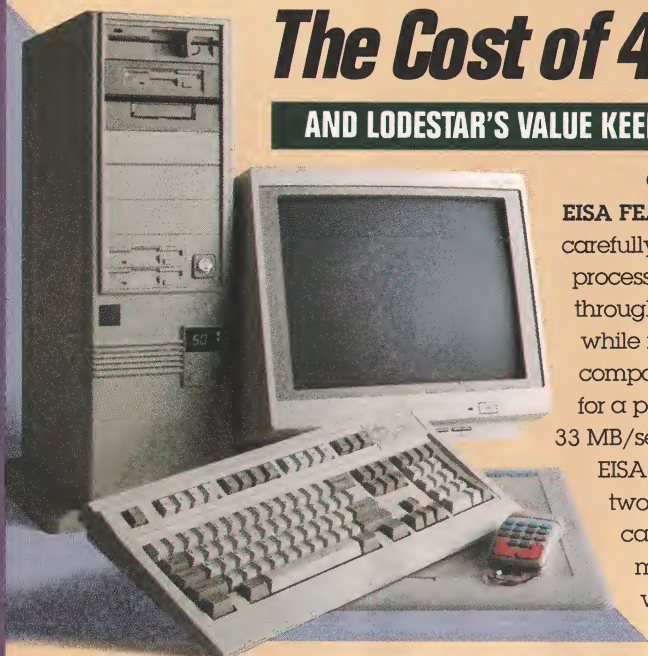
Buyer's Mart

From Accessories to Laptops to Word Processors, you can easily find the dealers you are looking for in this directory of products and services.

359

The Cost of 486 Power is Falling Fast.

AND LODESTAR'S VALUE KEEPS GOING UP:



CONSIDER THESE

EISA FEATURES: We've carefully designed a 32-bit processing solution that breaks through the ISA bottleneck while maintaining downward compatibility with a 16-bit Bus for a peak data transfer rate of 33 MB/sec. Six, true, fully blown EISA Bus Mastering slots plus two EISA slave slots so you can be assured your EISA mastering add-on cards will work for you (typical 8 slave slots won't).

LODESTAR's bus mastering, intelligent expansion cards with their own I/O processors operating in parallel with the main CPU, frees up your load on the CPU. Bus throughput is improved by implementing direct memory access (DMA) and bus masters.

Its speedy performance capability provides you with an ideal solution for a wide range of demanding applications, like CAD/CAM/CAE, formidable database management, image processing, artificial intelligence, desktop publishing and in the environments of network and multiuser systems.

NOW \$1259

486-SX Workstation

486-SX/20

- 4MB fast RAM expandable to 32MB
- 85MB 15ms IDE hard drive w/cache
- 1.1 interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" 1024x768 0.28mm dot pitch SVGA color monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Mini-vertical case

486-SX/25 \$1299

NOW \$1559

486 ISA Dataquest

486/33

- 64K ultrafast write-back cache SRAM
- 4MB fast RAM expandable to 32MB
- 130MB 15ms IDE hard drive w/64K cache
- Teac 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" SVGA 1024 non-interlaced 0.28mm dot pitch color monitor. VESA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Desktop case

NOW \$2029

486LB WINstation

486-DX/33

- 2 32-bit Local Bus expansion slots for 32-bit power expandability
- 64K ultrafast write-back cache SRAM
- Built-in 487 math coprocessor & 8K cache in the CPU
- 4MB fast RAM expandable to 32MB
- 130MB 15ms IDE drive w/64K cache
- High throughput Super IDE Caching Controller. Reduces average disk seek time to 0.2ms
- Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- 32-bit Local Bus S3 Graphics Engine w/1MB VRAM. Up to 1280x1024 resolution & 32,768 colors
- 14" 1024x768 non-interlaced 0.28mm dot pitch SVGA monitor. VESA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
- Enhanced 101-key keyboard
- Mid-vertical case

486-DX2/50 \$2199

486-DX/50 \$2309

486-DX2/66 \$CALL

NOW \$2969

486 EISA CADstation

486-DX/33

- 256K ultrafast write-back cache SRAM. Provides better hit-rate.
- Built-in 487 math coprocessor & 8K cache in CPU
- 8MB fast RAM
- 213MB 13ms IDE drive w/64K cache
- High throughput Super IDE Caching Controller. Reduces average disk seek time to 0.2ms
- Teac 1.2MB 5.25" & 1.44MB 3.5" drives
- 32-bit SVGA card w/1MB RAM. Up to 1280x1024 resolution & 65,674 colors
- 17" 1280X1024 SVGA non-interlaced color monitor. VESA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
- Enhanced 101-key keyboard
- Desktop or mid-vertical case

486-DX2/50 \$3139

486-DX/50 \$3229

486-DX2/66 \$CALL

Optional: 17" Viewsonic 7 Monitor

Some of our most astute customers are buying today, upgrading tomorrow.

To maximize the useful life of their systems, our customers depend on us. No need for them to unplug an obsolete system. They're using the power they need today and, with their LODESTAR StarFlex Series, they'll be upgrading simply, painlessly. LODESTAR's unique StarFlex CPU sockets are built right into the system. Upgradable all the way from 386DX to 486SX or 486DX, at any clock speed.

They keep coming to us because most other "upgradable" systems require purchase of a special CPU module board. This causes some performance loss due to speed adjustment. And they couldn't rely on those vendors being there when they needed to upgrade. Nor could they rely on sky-rocketing prices. So they've been calling LODESTAR.

Now Our Customers Are Getting It All—Value, Features and Price.

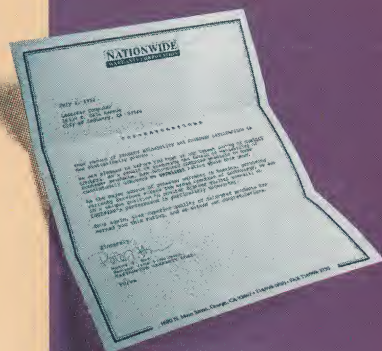


How thousands of our customers are **BUYING DIRECT**

When they buy from us, they're buying directly from the factory. So they get more value with each purchase, and are always assured their system is backed directly by the people who assembled it.

NOW

**THESE PRICES
GUARANTEED
THROUGH
DEC. 31, 1992**



**We Won Again.
And you enjoy the benefits.**

In their latest survey of **QUALITY CONTROL**, proven by this nationwide provider of warranty services, **LODESTAR** again has earned their rating **EXCELLENT**.

SHIPMENT WITHIN 48 HOURS

Every system is individually pretested and burned-in for 72 hours prior to shipment.

We have the right system for you. If it's not already configured, we'll customize it.

Systems can be upgraded to include optional cache, RAM, more hard disk capacity, larger monitor and a host of other enhancements.

NOW \$1099

386-SX Workstation

386-SX/25

- 2MB RAM expandable to 32MB
- 85MB IDE hard drive w/cache
- 1:1 interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" 1024x768 0.28mm dot pitch SVGA color monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Mini-vertical case

386-SX/33 \$1139

NOW \$1329

386-DX Workstation

386-DX/25

- 4MB RAM expandable to 32MB
- 130MB 15ms IDE hard drive w/64K cache
- 1:1 interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" 1024x768 non-interlaced 0.28mm dot pitch SVGA monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Desktop or mini-vertical case

386-DX/33 \$1359

386-DX/40 \$1389

NOW \$1399

StarFlex 3/486C

386-DX/25

- CPU upgradable to 386DX, 486SX, 486DX, 486DX2. Up to 66MHz
- 64K ultrafast write-back cache SRAM expandable to 256K
- 4MB fast RAM expandable to 32MB
- 130MB 15ms IDE drive w/64K cache
- 1.2MB 5.25" & 1.44MB 3.5" drives
- 1MB SVGA non-interlaced color card
- 14" 1024x768 non-interlaced 0.28mm dot pitch SVGA monitor. VESA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
- Enhanced 101-key keyboard
- Desktop or mini-vertical case

386-DX/33 \$1429

386-DX/40 \$1459

486-DX/33 \$1669

486-DX/50 \$1929

486-DX/50 \$2039

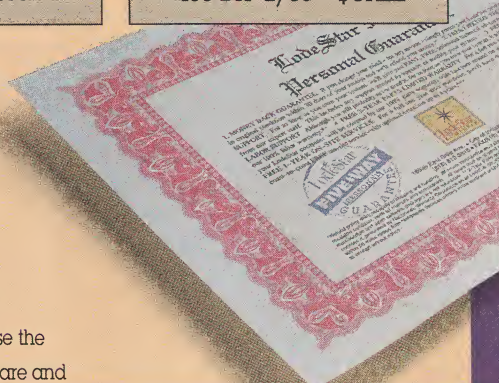
486-DX 2/66 \$CALL

Your Assurance of Complete Satisfaction

OUR RISK-FREE GUARANTEE

Look for your comprehensive, written guarantee when you take delivery of any **LODESTAR** system. This industry-acclaimed, **FIVE WAY** Personal Warranty proves our willingness to stand behind everything you buy from **LODESTAR**.

CALL FOR YOUR FREE COPY; we'll fax or mail it immediately. Use the **LODESTAR FIVE-WAY GUARANTEE** as your shopping guide; compare and question the others before ordering.



"YOU MADE US A LEADER."

1-800-875-3818



GOVERNMENT, SCHOOL AND CORPORATE ORDERS WELCOME. TO RECEIVE YOUR FREE COPY OF OUR PRODUCT CATALOG, JUST CALL.

All specifications subject to change without notice. 2-Year Parts Warranty applies to advertised LodeStar systems only. Money Back Guarantee does not include shipping & handling, and all returns must be shipped pre-paid & in reasonable condition. Please call to confirm all warranty details. Photography is for illustration only. No surcharge on VISA, MasterCard & Discover. Purchase orders are accepted on approved credit. California orders add 8.25% sales tax. All product names, trademarks and registered trademarks are the property of their respective companies. © 1992 LodeStar Computer Corp.

18539 East Gale Avenue
City of Industry, California 91748
Telephone: 1-818-810-3818
Tech Support: 1-800-875-7569
Fax: 1-818-810-5928

Open Hours:
Mon-Fri: 7am-7pm (PST)
Sat: 9am-4pm (PST)

Pick A Card

Volante

Draw
your
winning
card from
National
Design's
Volante Series



June 25, 1991
National Volante AT1000

of high speed graphics boards.

All Volante high speed graphics boards offer:

- Built on ISA, MicroChannel or VME bus
- Video memory upgrades to 4 MB
- Program memory upgrades to 4 MB
- Razor sharp resolutions from 1024x768 up to 1600x1280
- Blazing color selection from 8-bit to 24-bit true color
- Optional TI TMS34082 floating point processor for enhanced 3D acceleration
- Superior speed of the TI TMS34020 graphics engine paired with National Design's advanced ASIC technology
- LIFETIME WARRANTY - no gamble here!

Whether your game is CAD, Microsoft Windows, graphic arts, multi-media or medical imaging, Volante has a card for you at a fraction of the cost charged by the competition.

Call 800-253-8831 now for information
on the breathtaking Volante series.

Phone: 512-329-5055 Fax: 512-326-6326



NATIONAL DESIGN, INC.
1515 CAPITAL OF TEXAS HWY, SO.
5TH FLOOR
AUSTIN, TEXAS 78746

Circle 269 on Inquiry Card (RESELLERS: 270)



JDR Microdevices®

2233 Samaritan Drive, San Jose, CA 95124

Serving you since 1979

BUY WITH CONFIDENCE FROM JDR!

- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

MMC
MEMBER
HARVARD SCHOOL

UPRIGHT CASE

\$99⁹⁵

- Mounts 3 floppy and 4 hard drives
- Accommodates std. & mini motherboards
- 2 digit LED display

CASE-100A \$99.95

CASE-200 Super Deluxe Upright \$349.95

PS-250TW 250W p. supply \$129.95

PS-300TW 300W p. supply \$149.95

CASE-70 Std. 286-style case \$89.95

CASE-120 \$199.95

Mini-upright case w/200W power supply



POWER SUPPLIES

- U/L approved
- 110/220VAC, 50/60Hz

PS-150 8088 150 watt \$69.95

PS-200X 8088 200 watt \$89.95

PS-200 286/386/486 200 watt \$89.95

PS-300 286/386/486 300 watt \$149.95



ENHANCED KEYBOARD

\$49⁹⁵

BTC-5339 101/102-key enhanced layout \$49.95



NON-INTERLACED

1024 x 768 MONITOR

VGA-MON-1024N .28 dot pitch \$389.95

VGA-MON-1024 1024x768 int. monitor, .28mm. \$349.95

VGA-PKG-1024N Non-interlaced Super VGA pkg. \$499.95

VGA-PKG-1024+ 1024x768 interlaced VGA pkg. \$469.95

VGA-PKG 640x480 .39mm dot pitch VGA pkg. \$349.95

2400 BAUD MODEM

\$49⁹⁵

- Internal data modem
- Hayes compatible
- Config. as COM1-COM2

MCT-241 \$49.95



9600 BAUD EXTERNAL

\$299⁹⁵

- CCITT V.42bis/V.32/V.22bis/Bell 212A & Hayes AT command-set compatible
- MNP5 error correction & data compression
- 8 status LED's

VIVA-96E \$299.95



FAX/MODEM/PHONE SWITCH

- Save phone line charges!
- Supports fax, modem, phone and answering machine from 1 phone line

FAXM-SWITCH \$119.95

FAX-SWITCH Without modem connection \$89.95



PORTABLE IC TESTER

- Tests the following 14 to 20-pin devices: 74 series TTL, 40 & 45 series CMOS & 41/44 series DRAM up to 1Mb
- Identifies unknown part numbers

MOD-HIC \$129.95



WIRE-WRAP PROTOTYPE CARDS

JDR-PR2 8-bit with I/O decode layout \$29.95

JDR-PR10 16-bit with I/O decode layout \$34.95

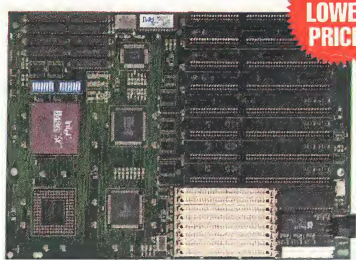
SOLDERLESS PROTOTYPE CARDS

PDS-601 8-bit breadboard-on-a-card w/I/O decode \$79.95

PDS-611 16-bit version \$89.95

MOTHERBOARDS

NEW
LOWER
PRICE!



25MHZ 386SX

\$199⁹⁵

- 25MHz Intel 80386SX CPU • Expandable to 8Mb on-board • Uses 256Kb or 1Mb SIMMs (OK installed)
- Six 16-bit and two 8-bit slots

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz cache 386 \$379.95

MCT-C386-33 33MHz cache 386 \$349.95

MCT-M286-16 16MHz 286 \$149.95

MCT-M286-12 12MHz 286 \$129.95

MCT-TURBO-10 10/4.77MHz 8088 \$69.95

MCT-M386SX-25 \$199.95

MCT-M486-50 50MHz cache 486 \$1195.00

MCT-M486-33 33MHz cache 486 \$895.00

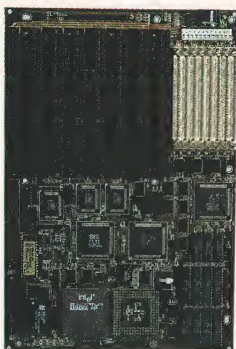
MCT-M486SX-25 25MHz cache 486SX \$499.95

MCT-C386-40 40MHz

Easy, Affordable

Get More Performance From Your PC System

RMB MOTHERBOARDS



Buy Smart...Buy RMB Upgradable Motherboards

Model	No Memory	2 Mb	4 Mb	8 Mb	16 Mb	32 Mb
386 SX-25	'149	'225	'301	'453	'729	NA
386 SX-33 16k	'169	'245	'321	'473	'749	NA
** 386 DX-33	'255	NA	'407	'559	'835	'1415
486 SX-25	'275	NA	'427	'579	'855	'1435
* 486 SX-25 Local Bus Slot	'349	NA	'501	'653	'929	'1509
* 486 DX-33 Upgradable	'599	NA	'751	'903	'1179	'1759
*** 486 DX-33 Local Bus Slot	'685	NA	'837	'989	'1265	'1845
*** 486 DX-50 Local Bus Slot	'899	NA	'1063	'1227	'1479	'2059
*** 486 DX-50 EISA Upgradable	'1150	NA	'1314	'1478	'1730	'2310

*64k Cache Memory **128k Cache Memory ***256k Cache Memory

Future Upgradability: 486 DX-33 to → DX-2/66 MHz or 486 DX-50 to → DX-2/100 MHz

486DX-50 MHz EISA only \$1150

Overdrive socket for easy 486DX-2 100 MHz upgrade. Local Bus Slot

• SIS ATQ chipset • AMI Bios • Intel CPU

The RMB Advantage

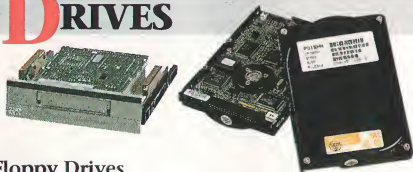
MIS managers from across the country are discovering the advantages of upgrading with RMB Motherboards:

- Save hundreds or even thousands of dollars by avoiding replacement costs with upgrades.
- Every RMB Motherboard with SIMM memory comes with the memory completely installed, burned-in and fully tested to assure quality performance.
- **Take the RMB challenge!** If you have an entire department to upgrade, try one RMB Motherboard for 30 days. If you're not completely satisfied, return it for a full refund.*

*Ralin will refund full product price.

Price will reflect purchase price or current market price, whichever is lower.

DRIVES



Floppy Drives

Epson®	1.2M 5.25" half height drive	\$69.00
Epson®	1.44M 3.5" in a 5.25" frame	\$69.00
Teac®	1.44M 3.5" drive	\$59.00
EPSON®	2.88M 3.5" in a 5.25" frame with controller card	\$169.00

Hard Drives

Conner®	CP-3000 40 Meg IDE with 28ms access time	\$169.00
Maxtor®	7080A 80 Meg IDE with 17ms access time	\$229.00
Maxtor®	7120A 120 Meg IDE with 15ms access time	\$289.00
Maxtor®	7213A 213 Meg IDE with 15ms access time	\$415.00
Maxtor®	LXT-340A 340 Meg IDE with 13ms access time	\$769.00

Tape Backups

Colorado®	DJ-10 Jumbo 120 Mb QIC-40 internal	\$197.00
Colorado®	DJ-20 Jumbo 250 Mb QIC-80 internal	\$257.00

VIDEO PRODUCTS

14" Super VGA Displays (interlaced)

Magnavox® CM9079 SVGA w/0.39 dot pitch	\$259.00
Aamazing® CM8489GX SVGA w/0.39 dot pitch	\$213.00
CTX® CVP-5439A SVGA w/0.39 dot pitch	\$229.00
Magnavox® CM9089 SVGA w/0.28 dot pitch	\$289.00
Aamazing® CM8428SX SVGA w/0.28 dot pitch	\$266.00
CTX® CVP-5468A SVGA w/0.28 dot pitch	\$269.00

14" Super VGA Displays (non-interlaced)

Aamazing® CM8428MX SVGA w/0.28 dot pitch	\$298.00
CTX® CVP-5468NI SVGA w/0.28 dot pitch	\$306.00

15" Display (Ralin's choice for Windows users)

CTX® CPS-1560 Flat Square Tube SVGA w/0.28	\$475.00
--	----------

17" Display (for the serious Windows user)

CTX CPS-1760 Flat Square Tube 1280 x 1024 w/0.28	\$865.00
--	----------

20" Display

Magnavox 20CM64 1280 x 1024 w/0.31 dot pitch	\$1275.00
--	-----------

Video Cards

RMB Trident 8900C w/1Mb up to 1024 x 768 Non-interlaced	\$75.00
RMB Windows Accelerator	\$75.00

CASES



Desktop Case

5-bays (3) 5.25", (2) 3.5"
16.3" w x 16" d x 7" h
200 watt power supply

\$87.00

Mini Tower

4-bays (2) 5.25", (2) 3.5"
7" w x 16" d x 13.6" h
200 watt power supply

\$75.00

Full Tower

9-bays (6) 5.25", (3) 3.5"
Digital Display.
230 watt power supply

\$139.00

Mid Tower Version

\$115.00

Call 1-800-752-9512 today and talk to the

Ralin Policies

- Prices and availability subject to change.
- Purchase orders are accepted, subject to approval.
- We do not charge your card until order is processed.
- Incomplete returns are subject to a service charge.
- All returns other than exchanged items incur a 10% re-stocking fee.

- Not responsible for compatibility problems and typos.
- 30 day guarantee does not apply to software. Defective software exchanged only.
- APO and FPO's please call for shipping charges or for credit card orders leave blank when mailing order and applicable charges will be added.

To insure your shipment arrives when you need it, Ralin uses only the most reputable modes of transportation available:



Upgrades.

For a Lot Less Than You Think.

MODEM UPGRADES

Zoom Telephonics

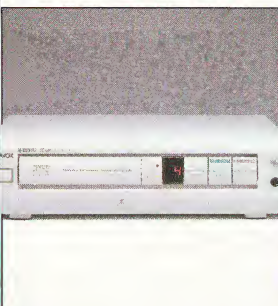
Zoom modems rate at the top of their class for compatibility and performance. The recipient of numerous Editors' Choice awards, Zoom modems offer the quality and dependability that you require at a price that makes them a true value.

All Zoom modems are backed by a 7 year warranty and are made in the USA.

2400 bps w/ v.42bis and MNP 2-5	(AMC) (AMX)	internal external	\$ 49.00 \$ 65.00
2400 bps w/ v.42bis and MNP 2-5	(AFC)	internal	\$ 59.95
9600 send & 4800 receive Fax	(AFX)	external	\$ 79.95
2400 bps w/ 9600 bps send/receive Fax	(FC 9624) (FX 9624)	internal external	\$ 79.95 \$ 95.00
9600 bps modem w/ v.32, v.42bis, MNP2-5	(VP-V32) (VX-V32)	internal external	\$ 199.00 \$ 199.00
14,400 bps modem w/ v.32bis, v.32, v.42bis, MNP 2-5 and 9600 bps send/receive Fax	(VFP-V32bis*) (VFX-V32bis*)	internal external	\$ 229.00 \$ 269.00
2400 bps modem w/.42 bis and MNP 2-5, 9600 bps send and 4800 bps receive Fax	PKT Pocket/Fax Modem		\$ 99.00

*WINFAX software option available for \$15 if purchased with VFP-V32bis or VFX-V32bis modem.

MPC UPGRADES



Magnavox®
CDD-461MM \$319.00
Combination external MPC CD-ROM drive and CD-audio player.

CDD-461GY \$399.00
Includes: Groliers Encyclopedia (MPC version), PC Glode/USA/Geo Jigsaw, Microsoft Bookshelf, PC SIG Library



Philips®
CM 205XBK \$329.00
Internal MPC CD-ROM player

CM 205XRS \$379.00
Includes: Groliers Encyclopedia and PC SIG



Sound Blaster
Pro Package \$179.00
2 FREE CD-ROM's, Wing Commander & Ultima VI and Chessmaster 3000

Ralin has sold thousands of upgrade components to Fortune 1000's, government agencies and home/office users and has the experience you need to make upgrading easy and affordable. With Ralin's unprecedented same day shipping policy, your components and equipment arrive when you need them. Call Ralin today... and be upgraded tomorrow.

PRINTERS

EPSON®

The solution to all your home and office printing needs. Crisp, clean 24-pin print quality that you expect from Epson and a unique 50 sheet tray that makes continuous feed paper a thing of the past.



AP-3250 •24 pin LQ
•200 cps draft / 72 cps LQ
•11k buffer
•5 letter quality fonts & 2 scalable fonts
•Two year warranty

\$191⁰⁰

9-Pin Printers

AP-2250	240/48 cps	\$133.00
LX-810	240/48 cps	\$167.00
FX-850	264/54 cps	\$288.00
FX-1050	264/54 cps	\$377.00
DFX-5000	533 cps	\$1265.00
DFX-8000	1066 cps	\$2145.00

24-Pin Printers

LQ-570	252/84 cps	\$259.00
LQ-870	330/110 cps	\$435.00
LQ-1070	252/84 cps	\$369.00
LQ-1170	330/110 cps	\$575.00
LQ-2550	400/133 cps	\$849.00

Star Micronics®

NX-1001	180/45 cps	\$129.00
NX-1020R	9-pin color printer	\$172.00
NX-2430	24-pin printer	\$239.00
NX-2420R	24-pin color printer	\$279.00
SJ-48	Inkjet	\$289.00

MATH CO-PROCESSORS

Cyrix® S25 for 386 SX-16, 20 or 25 MHz	\$69.00
Cyrix® D33 for 386 DX-16, 20, 25 or 33 MHz	\$87.00
Cyrix® D40 for 386 DX-16, 20, 25, 33 or 40 MHz	\$110.00

Upgrade Specialists.

Hours: 8:00 am to 7:00 pm Monday-Friday
Customer Service: 716-674-6267
Fax: 716-674-2108

WE ACCEPT:



WHOLESALEERS, INC.
P.O. Box 450
Orchard Park, New York 14127

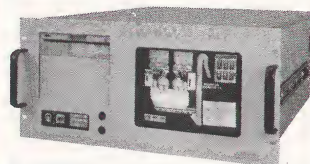
Rack Mount Computers - Motherboard or Passive Backplane

Use external monitor
Up to 6 drives



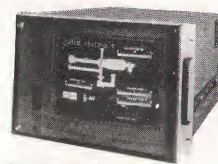
8.75" high

Mono or color monitor
Up to 5 drives



8.75" high

14" color monitor
Up to 3 drives



12.25" high

Rack Mount Monitors

10" mono or color
monitor



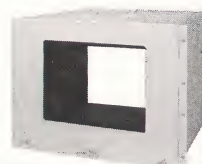
8.75" high

14" mono or color
monitor



12.25" high

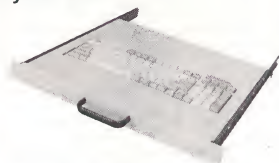
Enclosure for most
desk top monitors



14.0" high

Rack Mount Keyboards

Drawer mounted
keyboard



1.75" high

Drawer for desk top
keyboards



3.5" high

Vertical-mount, sealed
membrane keyboard



5.25" high

Rack Mount Printer

Dot matrix printer with
industrial rating



12.25" high

Complete '286, '386 and '486 systems

RECORTEC, INC.

1290 Lawrence Station Road, Sunnyvale, CA 94089

Tel. (408) 734-1290

Fax: (408) 734-2140

1-800-729-7654

BUFFALO®

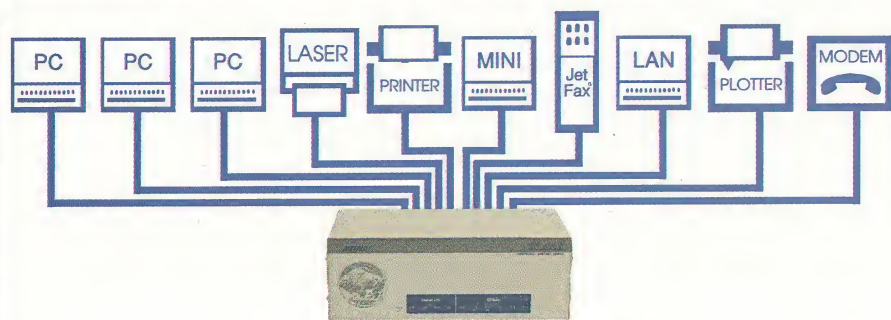
PRINTER SHARING SOLUTIONS



All your Computers.

All your Peripherals.

Shared with one box.



Buffalo SL Series Features:

• Two Models:

SLmkII - 4 parallel and 6 serial ports.
SLP - 8 parallel and 2 serial ports.

• Flexible Configuration:

Any port of your SL Series box may be set as either input or output.

• Rapid Data Transfer:

The SL Series software allows PCs to transmit up to 8,000 characters per second parallel and up to 115,200 bits per second serial, much faster than the DOS serial limit.

• Automatic Switching:

SL Series Buffalo boxes will automatically buffer data, convert between parallel and serial, and route data from your PC to the device of your choice. No commands are needed when sharing only one printer.

• User Upgradable Memory:

SL units are available with installed buffer memory from 256KB to 4MB. Buffer modules can be added later to expand any unit to the full 4MB.

• Easy Installation & Use:

Connect one cable for each PC or output device to the SL Series box. Run the SETUP program to configure the Buffalo box and to install the pop-up menu. Then, simply select your printer and print as you did before you installed the box.

• Pop-up Menu Option:

Select printers, macros, and other control functions using the cursor or a mouse. The pop-up menu appears over other applications and desktop publishing.

• Network Server Support:

Connected to a network server port, the SL Series can direct data to a variety of shared output devices.

• Windows Support:

Buffalo hardware and menu software are Windows compatible.

• Toll-Free Technical Support:

Skilled technicians will answer your call and help you achieve the best performance from your system.

• Cost-Effective Solutions:

Prices for the SLmkII and the SLP range from just \$595 with 256KB of memory to \$995 with a full 4MB installed.

• Smaller Alternatives:

The Buffalo H Series is also available priced from \$245 for the HXP with 4 parallel ports and 256KB of buffer. The H Series buffers offer expandability to 16MB of buffer and parallel data transfer at up to 180,000 characters per second.

• Toll-Free Application Advice:

Our knowledgeable staff will help you select products to fit your needs.

• One Year Warranty

• 45 Day Money-Back Guarantee

US and Canada Toll-Free

1-800-345-2356

(503) 585-3414

FAX (503) 585-4505

Buffalo Products, Inc.

2805 19th St. SE, Salem, OR 97302

Response Code: B2SL3

BUFFALO is a registered trademark of Melco, Inc. Other brands and product names are trademarks or registered trademarks of their respective owners.

Australia	Miden	03-321-0102
Belgium	Vision	016-400416
CSFR	Alwil	02-782-25-48
Denmark	JPS	42-95-3888
	Ivaercenter	38-89-0909
Finland	Oy Amittel	0-351-5055
	Nordic	0-803-6033
France	LPE	01-4827-6736
Germany	Graphtec	08152-7912-(0)-50
	Leunig	02241-66071
Hong Kong	AE	861-2112
Israel	Usser	3-560-3837
Iran	Vision	21-801-7312
Italy	SPH	02-261-0051
Netherlands	Computada	073-440700
New Zealand	Cable Plus	09-262-2851
International	Neotex	FAX 81-45-641-5417

How Can I Have

SYSTEMS

ALL SYSTEMS INCLUDE:

- 4MB RAM on 32MB Motherboard
- 2 Serial, 1 Parallel, 1 Game Port
- 2 Floppies, 1.44 & 1.2 MB (3-1/2" & 5-1/4")
- DynamicScan, Super VGA Monitor .28 DOT, 1024x768, Tilt & Swivel
- 1MB, Super VGA Card
- 101 Keyboard, Non-Click or Click
- Min. 200W Noiseless Power Supply
- 8 Expansion Slot
- Windows 3.1 and Mouse (2600DPI), DOS 5.0

Synchronous 32Bit Local Bus

66, 50 and 33MHZ available now!

- 486-66MHZ, 256K Cache, w/Local Bus.....Call Price
 - 486-50MHZ, 256K Cache, w/Local Bus\$1,589.00
 - 486-50MHZ, 256K Cache, w/ISA Bus.....\$1,499.00
 - 486-33MHZ, 256K Cache, w/Local Bus\$1,349.00
 - 486-33MHZ, 256K Cache, w/ISA Bus.....\$1,259.00
 - 386-40MHZ, 64K Cache, AMI BIOS Upgradeable to 486-66MHZ\$998.00
- "Made in USA Motherboard"

OPTION:

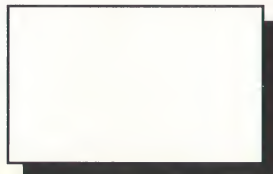
NonInterlaced DynamicScan 72 SPVGA Monitor.
1024 x 768, .28 DOT, 72HZ, Add.....\$49.00

HARD DRIVES: - Call For Best Price

80MB	100MB	120MB	200MB	300MB	600MB	1.2GB
14MS	16MS	14MS	14MS	14MS	15MS	14MS

The Fastest P.C. Configurations:

486-66MHZ
Motherboard
256k external Cache
16MB RAM Installed



IDE 32BIT
Synchronous
Local Bus
4MB RAM Cache
Less than .3MS



Dual Synchronous 32Bit Local Buses
The Fantasy Combinations/VGA & IDE Caching

- 300MB IDE Hard Drive plus 32Bit Local Bus
- Comes with 4MB RAM Write Back Cache
- Speed Up Windows or AutoCAD
- 32Bit Local Bus
- 16MB RAM INSTALLED
- 256K Write Back S.RAM Cache
- Dual local Buses



\$3,789.00



- 15" Flat Screen Flicker Free
- .28 DOT, 1024 x 768
- Low Emission

**The Best Application
for File Server, CAD
Station, Graphic Art,
Data Base**



- Click or Soft Touch 101 Keyboard

**30 Days Money Back Guarantee
On site service to Most Locations**

**The Price is changed
without notice**

The Fastest PC?

MOTHERBOARD

486-50MHZ, Local Bus
w/S3 VGA Card Set
.....\$989.00

486-EISAor ISA
Please CALL

386-40MHZ, 64K
AMI Bios\$229.99

Upgradable to 486-50
386-40MHZ\$279.00

386-SX25MHZ..\$139.00

386-SX16MHZ..\$119.00

GRAPHIC CARDS

Trident, 1MB.....\$69.00

SpeedStar Stealth,
1MB\$249.00

Renoir Hi Color,
1MB\$189.00

Tseng Lab, 1MB RAM,
32K Colors.....\$119.00

FLOPPY DRIVES

Teac 1.44MB.....\$52.00

Teac 1.2MB.....\$58.00

JPN 1.44MB.....\$51.00

JPN 1.2MB.....\$57.00

HARD DRIVES

MaxtorCALL

SeagateCALL

ConnerCALL

Western DigitalCALL

CASES & POWER SUPPLIES

AT Mini Tower
w/200W P.S.\$59.00

AT Medium Tower
w/200W P.S.\$89.00

AT Big Tower Case
w/230W P.S.\$129.00

MONITORS

1024 x768 Non-
interlaced SuperVGA
Package \$368

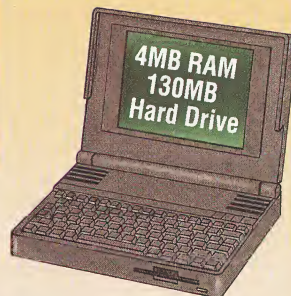
- .28 DOT Pitch
- 16 bit Spvga Card w/
1MB RAM
- 256 Colors at 1024x768
- 14" Monitor
- Drivers support
major programs
- Monitor Only \$289

FAX/MODEM SWITCH

- Save phone line!
- Does not require
dedicated line
- Support FAX/
Modem/Phone
- Intelligent Auto
Switch \$69

Any Name Brand
Please Call for the
best price

DYNAMICSCAN 486-33MHZ DX NOTEBOOK



- Complete Set
.....\$2,299.00
- 386-DX 33MHZ w/80MB
- HardDrive...\$1,889.00
- No Hidden Price

MISCELLANEOUS

MemoryCALL

Printers.....CALL

Any Model
FAX/ModemCALL

We Offer Any Custom Configuration.
Lanctic. Novell Lan System.

All Systems Include The Following
Software Package That Even The Novice
Can Use.

- Easy Menu
- Lotus Tutor
- Bible
- Accounting
- DOS Tutor
- Word Processing
- Data Base
- Real Estate
- Variety of Games and
Educational Programs

Test a DynamicScan System yourself with
a 30-day money back guarantee.

With the purchase of any DynamicScan
System, you will have access to unlimited
technical support with our "800"
DynamicScan Users Number.

Warranty-1 Year On-Site Service to most
locations.

DynamicScan

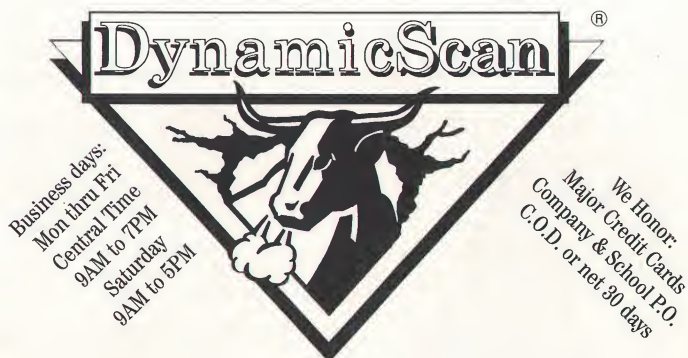
10824 Page Avenue
St. Louis, Missouri 63132

SALES/ORDERS.....314-423-0044

FAX314-426-4014

EXPORTING314-428-7734

TECH SUPPORT AND RMA
800-852-3273



16MB TECHNOLOGY NOW!!!

ACER 486sx - 16MB SIMM (4M X 36)	\$ 539.00
32MB SIMM (8M X 36)	\$ 1699.00
COMPAQ SystemPro - 32MB MODULE	\$ 1299.00
DELL 486's - 16MB KIT (2 SIMMS)	\$ 538.00
32MB KIT (2 SIMMS)	\$ 1078.00
MAC IIfx - 64MB KIT (4 SIMMS)	\$ 1956.00
MAC QUADRA 950 - 64MB KIT (4 SIMMS)	\$ 1956.00
MAC IIfx, IIfcx, QUADRA 900 - 64MB KIT (4 SIMMS)	\$ 1956.00
MAC QUADRA 700 - 64MB KIT (4 SIMMS)	\$ 2156.00
SUN IPX, ELC - 16MB SIMM	\$ 499.00

OTHER MEMORIES AVAILABLE...

IBM		COMPAQ		HP		LAPTOPS	
PS/1 - 2MB	\$ 68	DP 386/20,20E,25 - 1MB	\$ 66	Vectra QS-16 - 2MB KIT	\$ 129	AST EXEC. NB - 4MB	\$ 135
4MB	\$ 149	4MB	\$ 168	4MB KIT	\$ 229	COMPAQ LTE386 - 4MB	\$ 229
M30 - 2MB	\$ 92	DP 386S/16 - 1MB	\$ 66	Vectra 486 - 2MB	\$ 89	SLT386 - 4MB	\$ 168
M50Z,55sx,65sx,70 - 1MB	\$ 45	4MB	\$ 168	4MB	\$ 149	DELL 316,320 LT - 2MB	\$ 99
2MB	\$ 89	DP 286N,386N,S/20 - 4MB	\$ 149	8MB	\$ 299	EVEREX TEMPO - 2MB	\$ 78
M55sx,65sx,70 - 4MB	\$ 149	M-SYSTEMS - 2MB	\$ 89	X-Station 700 Ser. - 2MB	\$ 89	IBM L40sx - 4MB	\$ 160
M70-A21,A61,121 - 2MB	\$ 90	4MB	\$ 149	4MB	\$ 149	MAC POWERBOOK - 2MB	\$ 104
M40sx,35sx - 8MB	\$ 299	8MB	\$ 299	8MB	\$ 299	NEC P.S. 286,386sx - 4MB	\$ 200
M57sx,90,95 - 4MB	\$ 155	DP 386/33,486/25 - 2MB	\$ 96	9000/400t,425t - 8MB KIT	\$ 495	P.S. 386 - 8MB	\$ 429
8MB	\$ 309	SystemPro - 8MB	\$ 315	16MB KIT	\$ 999	P.S. SX/20 - 4MB	\$ 200
M80-Q41 - 1MB	\$ 65	OK Exp. Brd	\$ 335	32MB KIT	\$ 1869	PANASONIC CF170 - 1MB	\$ 55
M80-111,121,311 - 2MB	\$ 99	DP 386S/16 1MB Exp. Brd	\$ 105	9000/425e - 8MB KIT	\$ 428	T.I. TRVL-MT 3000 - 2MB	\$ 80
M80-A21,A31 - 4MB	\$ 195	DP 386/20,20E,25,25E		16MB KIT	\$ 828	TOSHIBA 1000 - 2MB	\$ 108
16-BIT OK Exp. Board	\$ 128	1MB Exp. Board	\$ 105			2000SX - 8MB	\$ 388
32-BIT OK Exp. Board	\$ 155					3200SXC - 4MB	\$ 160
						5200 - 8MB	\$ 315
AST		DELL		APPLE		PRINTERS	
PREM. 386/20C - 1MB KIT	\$ 65	325D,P;333D,P - 1MB	\$ 45	II,SE,SE/30 - 1MB	\$ 32	EPSON 6000 - 4MB	\$ 229
PREM. 386/25 - 1MB	\$ 45	4MB	\$ 149	Classic - 1MB Exp. Board	\$ 54	HP IIP,III,IID,P - 2MB	\$ 108
PREM. 486/25 - 1MB	\$ 45	420,425,433 - 2MB KIT	\$ 90	SE/30,IIfx,IIfcx,IIfs,LC &		IIfs - 4MB	\$ 135
PREM. II 486 - 1MB	\$ 45	4MB KIT	\$ 178	Quad. 700,900 - 4MB	\$ 115	IBM 4019,4029e - 3.5MB	\$ 140
4MB	\$ 155	8MB KIT	\$ 298	Quad. 700,900 - 32MB KIT	\$ 1120	4029 - 4MB	\$ 135
8MB KIT	\$ 310	450DE,450SE - 2MB KIT	\$ 90	IIfx - 16MB KIT	\$ 499	OKIDATA 400 - 2MB	\$ 129
PREM. II 1MB Exp. Board	\$ 469	4MB KIT	\$ 178	IIfx - 32MB KIT	\$ 1156		
		8MB KIT	\$ 298	Quadra 256K V-RAM	\$ 30		
				LC 512K V-RAM	\$ 47		

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

OTHER MEMORIES FOR:

ACER, ALTIMA, APPLE, AST, CHAPLET, COMPAQ, DELL, EPSON, EVEREX, HP, LEADING EDGE, IBM, NEC, NCR, OKIDATA, PACKARD-BELL, PANASONIC, PHILIP, SAMPO, SHARP, SILICON GRAPHICS, SUN MICROSYSTEMS, TANDON, TI, TOSHIBA, TULIP AND ZENITH.



CALL FOR OUR COMPLETE CATALOG

TERMS: C.O.D. CASH, VISA OR MASTERCARD.
COMPANY AND UNIVERSITY P.O.'S ACCEPTED UPON CREDIT APPROVAL.

414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706
TEL. (818)855-5688 FAX (818)855-5687

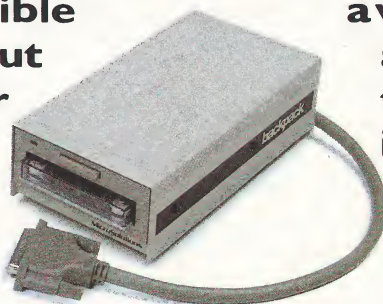
ALL PRODUCT NAMES, TRADEMARKS AND REGISTERED TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE COMPANIES.

TWO COMPUTERS CAN SHARE ONE BACKPACK.



With Backpack, several computers can share a single tape drive. Backpack connects quickly and easily to the parallel printer port of any PC compatible or portable – without interface cards or tools! The Backpack tape drive is also easy to transport, making it ideal for trans-

ferring data from one computer to another. QIC 40 (40/120MB) and QIC 80 (80/250) tape, diskette and hard drive models are available. So share and share alike! Call today for more information.



See us at
COMDEX/Fall '92
Booth #H8840

backpack

MicroSolutions
Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115 815-756-3411 Fax 815-756-2928

The Ultimate in Handheld Computers

BICOM B260i



30-Day Money Back Guarantee
\$100 Rebate for the first 50 Customers

ABC COMPUTERS®

ABC Computer (USA) Corp.
2531 237th Street, Suite 122, Torrance CA 90505
310-325-4005 Fax 310-325-6369



1-800-336-2280

See us at
COMDEX®/Fall '92
Booth S674

- Weight 2.2 lbs. (Bicom and Battery)
- Dimension 8.78" x 6.36" x 1.22"
- True 16 bit AMD Lonestar Processor, 386SX Class Performance
- 5 "AA" size NiMH Batteries, 4-hour operation*
- 60 MB Hard Disk Drive
- 2MB RAM expandable to 4MB on board and 16MB with memory card
- PCMCIA 2.0/JEIDA standard port for memory card and I/O card
- 640 x 400 resolution LCD screen supports CGA, AT&T mode and all Windows graphics
- 64-key keyboard
- 1 parallel (bi-directional)/ 1 serial
- External FDD port for optional Floppy Drive
- DR-DOS 6.0, File Transfer Software & Serial Download Cable
- Built-in Personal Data Manager software
- Built-in Programmable Power Management Software
- Universal AC/DC adaptor
- Carrying Case

\$1250

Options: External Floppy Drive, SRAM Memory Cards, 9624 IC Card
Fax/Modem, Mini-trackball, External Keyboard, extra batteries.

Circle 287 on Inquiry Card (RESELLERS: 288).

*Battery life is measured with power management enabled.
All brand names are registered trademarks of their respective owners.

HORIZONS

A report on power protection.

Best Power Technology, Inc. • P.O. Box 280 • Necedah, WI 54646 • Toll-Free: 800-356-5794 (U.S.A. & Canada) • Telephone: (608) 565-7200 • Fax: (608) 565-2221

Disaster Avoidance, see page 3

IBM users vote BEST's UPS number ONE for second straight year

For the second year in a row, BEST has been named the top UPS by 50,000 owners, users, and buyers of IBM AS/400, RS/6000, and Systems/3X computing products. The FD series FERRUPS® was selected for the coveted 1992 Midrange Systems Buyers Choice Award.

The award recognizes the most innovative and reliable products and services in the IBM midrange computing industry. Winners are chosen by *Midrange Systems* subscribers. "Being selected as a Buyers Choice Award winner by the market's most influential buyers is a significant honor," according to the magazine's Associate Publisher, John Curran. "This recognition is a tribute to your entire organization, from R&D to marketing and sales. There's no bet-



ter endorsement than a satisfied customer."

FERRUPS is BEST's line of advanced, on-line, line-interactive UPS. Products feature Artificial Intelligence, automatic battery and inverter

checks, alarm and inverter logs, five indicator lights, 16 audio alarms, RS232 communications, and more than 100 operational parameters that may be monitored or programmed by the user.

FERRUPS also features:

- Sine-wave output
- 2000-to-1 spike attenuation
- Complete galvanic isolation (including output neutral-to-ground bonding)
- 120 dB of common-mode noise rejection
- True no-break power

BEST won the Buyers Choice Award over manufacturers in both the single- and three-phase UPS markets. Competitors included American Power Conversion, Sola, Tripp-Lite, Liebert, and Minuteman.

BEST wins top honors in all five UPS categories in Computerworld study



The top honors in all five Uninterruptible Power System (UPS) categories in the 1992 *Computerworld* I/S Brand Preference Study went to Best Power Technology, Inc.

In the study, which focused on

Local Area Network products, 515 *Computerworld* subscribers were asked which manufacturer they most closely associated with five areas of product excellence. BEST got highest consumer ratings in the categories of *Best Technology*,

Best Price/Performance, *Best Service/Support*, *Best Documentation*, and *Prefer to do Business With*. BEST won with fairly wide margins — as much as 32 percentage points higher than its closest competitor.

Circle 391 on Inquiry Card.

Fortress leads the pack in LAN Technology review

BEST's newest Uninterruptible Power System, Fortress®, has received the coveted "Network Specialist Preferred" rating from *LAN Technology*. Fortress showed the best performance of the seven leading UPS products tested.

"Aptly named, the Fortress produced rock-solid, stable power under all test conditions," the magazine stated in its April 1992 issue. "On the strength of its electrical performance, the Fortress topped the seven products in our review."

In fact, the Fortress was the *only* product that provided uninterruptible, no-break power in every test. Other products tested had power breaks lasting as long as nine milliseconds. Some gave square-wave output with as much as 33 percent total harmonic distortion.

Other products tested included "UPS" from American Power Conversion, Tripp Lite, Sola, and Para Systems.

LAN Technology's editors were impressed at what they found. "The LI 660 shined in our tests," they wrote. "It did not follow the over-voltage condition, and instead delivered a constant 115 Volts rms to the load. The unit's output had less than three percent total harmonic distortion for all conditions. In both the



one-cycle dropout and power outage tests, the LI 660 provided smooth, sinusoidal power to the test load.

"The LI 660 . . . was a fine piece of equipment, and we picked it as the top performer in the review," the editors concluded.

Other products tested did not fare as well, however. For instance, APC advertises a maximum three milliseconds transfer time for its Smart UPS 600 standby system. But in the *LAN Technology* one-cycle dropout test, the Smart UPS broke power for a full 4.5 milliseconds — hardly an "uninterruptible" performance. As the editors noted, the Fortress "was not measurably affected by the one-cycle dropout."

Government Computer News editor: "Fortress is my main UPS"

The applause for Fortress, the world's smallest, smartest, true no-break UPS, continues to roll in!

The latest comes from John McCormick, who writes the "Power User" column for *Government Computer News*. In his March 16, 1992 column, "In the Dark About Emergency Power Supplies," he shares his insights on UPS.

"Washington is a real power city, but recent power- and water-related incidents in Washington have brought a new meaning to the term 'power user,'" McCormick wrote in the column. "I have a lot of sophisticated computer equipment here. Without reliable power, I would have nothing when the lights go out."

A stickler for quality and long runtimes, McCormick relies on BEST technology. "A Fortress LI 2K from BEST is my main UPS," he writes. "The control and display capabilities of the Fortress are impressive, starting with a countdown of the time left when operating on the battery."

The reviewer was also impressed by the fact that Fortress "will run equipment beyond its rated capacity, and audibly warn you to shut something off. Line, output, and battery voltages can all be displayed, as well as a percentage of load reading."

As a power user, McCormick appreciates the flexibility that Fortress' digital display and keypad give him. "There are so many options that one important setup step is to decide on what is important for your installation and reset those features from factory defaults."



Disaster avoidance and recovery is growing business priority

Computing and telecommunications disasters are increasingly headline news. One of the most recent occurred when AT&T lost a major switching center in downtown New York City for seven hours due to a power failure on September 17, 1991. The crash blocked 5.5 million calls, closed New York's airports, and disrupted more than 1,000 flights.

More recently, Chicago's thriving "Loop" district was completely shut down in mid-April of this year, when the Chicago River flowed through a hole in an old freight tunnel, flooding the basements of scores of high-rise office buildings. Commonwealth Edison shut off electrical power to the entire area to protect its transmission equipment, forcing the closure of the Mercantile Exchange and the Chicago Board of Trade. Worldwide stock and commodities trading was disrupted, and business losses were estimated at as much as \$50 million per day.

With nightmares like these in the news, it's little wonder that businesses across the country are scrambling to develop ways to avoid major power disasters. AT&T is actively recommending this type of planning to its customers.

The concern is justified. The Enterprise Technology Center recently reported a number of terrifying statistics:

- On average, a company loses as much as three percent of its gross sales within eight days of a sustained computer outage.

- The average company struck by a computer outage lasting more than 10 days **will never fully recover**. Half of these companies will be out of business entirely within five years of the outage.

- Your chances of experiencing a disaster are one in 100.

- Power outages were one of the three most common causes of disaster in 1989 and 1990.

Power Quality, a trade journal for utility officials and others in power-related industries, recently devoted an entire issue to the topic of disaster avoidance and recovery. "Today, large areas of business and other activities depend on continuous operation of computers linked by telecommunications companies," power consultant Harold Morser wrote in one of the articles. Morser named a number of major industries that are easily crippled by computer and telecommunications disasters, including:

- International banking
- World stock markets
- Insurance companies
- Government agencies
- Airlines

In other applications, the loss of computing or telecommunications capability may imperil life itself. Among these, Morser listed:

- Life-support equipment in hospitals
- Intercommunication and management of fire, police, and ambulance services

"Failures or errors in any of these systems carry severe penalties for providers and users," Morser writes.

Morser recommends the use of an Uninterruptible Power System (UPS) to avoid short-term power failures, and a UPS backed by a generator for avoiding longer ones. But he admits that traditional approaches to long-term power protection aren't always cost-effective.

Moreover, generators and battery banks used for power support need careful tending, Morser notes. "My personal view as a former diesel engineer is that operating life and reliability are far better if the [generator] is run for sustained periods . . . on a regular basis," he writes.

UBS® — A cost-effective approach to disaster avoidance

Fortunately, there is an affordable, reliable solution to the threat of computer and telecommunications failures — BEST's "Infinite" Battery System (UBS®).

This revolutionary, cost-effective approach to extend Battery Reserve Time is the perfect solution to provide Hours, Days, or even Weeks of

Continued on page 4



"Infinite Battery" solves disaster avoidance problems

Continued from page 3

continuous, high-quality, DC power.

Traditional solutions to extend a facility's battery reserve time require the addition of parallel ranks of batteries, or the replacement of the existing battery plant with one having a larger ampere-hour capacity. Simply adding batteries to the system requires additional floor space, increases the maintenance required for the system, and often requires additional battery charging equipment. These additions are expensive, add to the complexity of the power system, and reduce the system's overall reliability.

BEST's "Infinite" Battery System (UBS®) is unique in providing DC power for extended Battery Reserve Time. It does so without the problems associated with battery plant additions, or those associated with AC phase control and transfer switch operation. The AC generator output waveform ceases to be a concern, and frequency stability problems vanish.

To ensure reliability, the micro-processor-controlled UBS® has an *automatic self-diagnostic* test system. It automatically monitors parameters such as *fuel, oil, and cranking battery power* and sounds an alarm if the UBS® fails any system check. A total of 55 *system parameters* can be *monitored, controlled, and forwarded* to remote central maintenance facilities. The UBS® also allows for remote control and monitoring using a password-protected system. A keypad and display allow for local monitoring and control of the UBS® unit.

The UBS® is automatically cycled to run for 20 minutes every two weeks to ensure reliable automatic starting when needed.

UBS® by BEST is the first power source designed specifically to provide high-quality, reliable DC power for essential UPS and communication systems.

BEST leads industry with Double Lifetime Warranty

Competitors rush to "clone" innovative program

Best Power Technology has once again demonstrated its leadership in the UPS industry by announcing a first in the power protection industry; a limited Double Lifetime Warranty on all its power protection products.

The Double Lifetime Warranty applies to the transient surge suppression circuitry in each FERRUPS®, Fortress®, Patriot™, Citadel™, or SpikeFree™ sold by BEST for installation in the United States and Canada.



Not surprisingly, competitive manufacturers have scrambled to improvise "me-too" warranties. But BEST's leadership in this area is driven by its proven track record of product reliability and performance.

Subject to certain terms and conditions, this bonus warranty extends BEST's basic manufacturer's warranty to offer repair or replacement of transient surge suppressor circuitry in the event of defective material or workmanship or circuitry damage through normal use during the life of the product. Also, this expanded coverage includes reimbursement of up to \$25,000 per occurrence of physical damage to specified computer equipment damaged as a result of defective surge suppression circuitry.

Full details of this warranty coverage can be obtained from a

BEST dealer or by calling BEST at 800-356-5794.

BEST, the world's largest manufacturer of single-phase UPS, is the first in the power protection industry to offer this type of warranty on UPS, SPS, and power conditioners, as well as surge suppressors.

According to Best Power Technology Sales Corporation President Bill Paul, "The new Double Lifetime Warranty demonstrates our confidence that BEST products will protect computers and other sensitive electrical equipment from lightning and surges. Each power protection solution BEST offers has advanced surge suppression capabilities. And we're willing to stand behind our products with the best warranty in the business."

Paul isn't troubled by the crowd of clone warranties hastily introduced after BEST announced its program on January 1, 1992. "It's not the first time we've led the way in power protection," he said. "Besides, given the marginal field performance of some of these competitive units, it's questionable how long their manufacturers can afford to provide this kind of coverage."

For more information on Best Power Technology's products and services, and how they can benefit you, contact:



Best Power Technology, Inc.
P.O. Box 280
Necedah, WI 54646 - U.S.A.

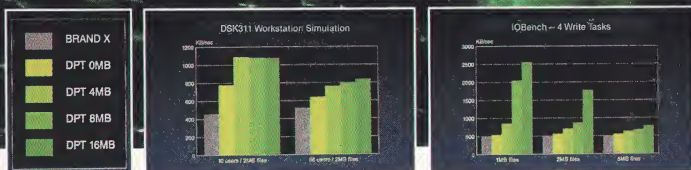
Toll-Free: 800-356-5794, ext. 4229
(U.S.A. and Canada)
Telephone: (608) 565-7200, ext. 4229
Fax: (608) 565-2221
Telex: 701934
(Best Power UD)



DPT

Break into Higher Performance!

SmartCache Plus is the SCSI controller that delivers higher performance without a higher price!



Windows, Netware, Unix and other high-end applications need a SCSI controller that delivers top disk I/O performance and a growth path. Only SmartCache Plus delivers both — and costs no more than less advanced controllers!

As the industry's fastest SCSI controller, SmartCache Plus is the easy choice. It's the smart choice, too — because if your system needs a performance boost, you can transform it from a non-caching host adapter into the world's fastest *caching* controller! Expandability is so simple: plug-on modules add caching, up to a total of 16MB of cache memory, and disk mirroring!

SmartCache Plus is supported by all major operating systems and applications, and provides connectivity to hundreds of SCSI devices. Reliable, scalable and simple to install, SmartCache Plus breaks your system's disk I/O bottleneck without breaking your budget!

Distributed Processing Technology
140 Candace Drive, Maitland, FL 32751

All trademarks are the property of their respective owners.

Circle 262 on Inquiry Card (RESELLERS: 263).

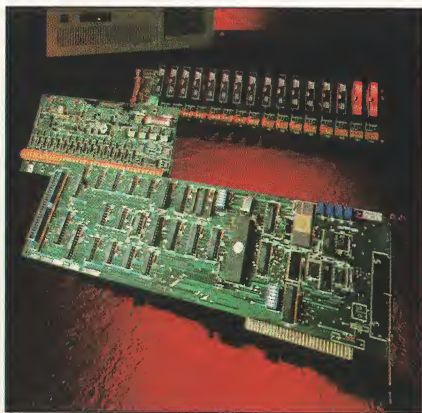
GET THE FACTS!

This free comprehensive Performance Report details the SmartCache Plus advantage over its leading competitor in nine different benchmarks for DOS 5.0, Netware 3.11 and Unix applications. For your copy, contact DPT Channel Marketing today...

TEL. **407-830-5522**
FAX **407-260-5366**

See us at COMDEX Booth No. 1596

CyberResearch System of the Month Features RTI® DAS from Analog Devices

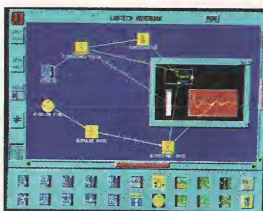


Package includes LABTECH NOTEBOOK

The RTI series of data acquisition boards were designed by Analog Devices with industrial users in mind. With the lowest failure rate in the industry, these are the boards to choose when reliability is critical. Designed from the outset to be compatible with the full line of Analog Devices' signal condition-

ing modules, RTI boards can be used for the broadest possible range of data acquisition applications.

CyberResearch has now made this top-of-the-line product affordable for everyone. By bundling an RTI 815A together with LABTECH NOTEBOOK® software at one low price, we've saved over \$500 and made it possible for you to afford the very best.



Labtech Notebook

Each combination package includes:

- **RTI 815A** data acquisition board configured for 32 Single-Ended or 16 Differential analog input channels with a 50KHz A/D conversion rate, 2 analog output (D/A) channels, 16 Digital I/O lines, and 3 Counter/Timer I/O channels.
- **LABTECH NOTEBOOK** menu-driven software with new IconView diagramming user interface and drivers for controlling the RTI 815A board.

Order #RTI 815LN RTI DAS Combination Package. \$1995

Guarantee Valid Data with Signal Conditioning Modules

Signal conditioning modules serve several purposes; they protect your computer, isolate your signal of interest from noise, amplify low-level signals, and provide power and excitation to transducers.

One name is virtually synonymous with signal conditioning: **Analog Devices**. And CyberResearch is your Analog Devices distributor carrying every signal conditioning line: the versatile **3B** series, the low-cost **5B** series, and the new, intelligent **6B** series with on-board A/D conversion.

Call 800-394-3300 to receive additional information.



Low-cost
5B
Series
Modules

Circle 392 on Inquiry Card.

VGA to Video Converter — VGA to your VCR



Redlake's **TapeCaster** converts VGA screen output to video for applications such as recording animation and creating training tapes. The TapeCaster is extremely easy to use: no base addresses, no interrupts, no software required — just plug and play.

- True, precise NTSC/PAL video timing.
- Simultaneous VGA & video display.
- Composite Video & Y-C (SuperVHS) output for use with equipment ranging from an inexpensive VCR to broadcast-quality professional video. This is a full-color image acquisition board, not monochrome with pseudo-color.

from an inexpensive VCR to broadcast-quality professional video. This is a full-color image acquisition board, not monochrome with pseudo-color.

#NTSC 200 TapeCaster — NTSC Video Output (For use with VCR's in the U.S.A.)\$750

#PAL 200 TapeCaster — PAL (European) Video Output\$750

Circle 393 on Inquiry Card.

New A/D Board perfect for Portable Systems

Designed specifically for use in portable PC's, the **PC 126** from United Electronic Industries packs a lot of power into a small package. Unlike many A/D boards, the PC 126 operates entirely on +5V power, usually the only power available in a portable. It's features include:

- 50kHz A/D sampling @ 12-bit resolution
- 16 Analog Inputs and 2 Analog Outputs.
- **Free:** Driver software with source code in C, menu-driven Status-30 software, and data streaming-to-disk software.
- Consumes 190mA @ +5V (less than 1 Watt!)
- 8 Digital Inputs & 8 TTL Digital Outputs.

#PC 126 16-Channel 50kHz Data Acquisition Board with software\$545

#INST 347 50-Terminal Screw Terminal Block with 2-Meter Cable to PC 126\$105

Circle 396 on Inquiry Card.



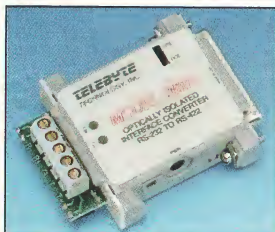
Opto-Isolated RS-422 Converter Protects Your PC

Your computer can be protected at the power supply, but suffer a devastating shock from power surges picked up over long data lines. The Model **262** converter from Telebyte Technology serves double-duty, providing both high-speed RS-232 to RS-422 conversion and optical isolation.

- **Optical isolation exceeds 10,000 Volts**
- Earth ground connection
- Switch selection of DCE or DTE
- LED status indicators on data lines
- Wall transformer powers the unit
- Data Rates to 19K baud over 2 miles
- RS-232 Connector: DB-25 (select Male/Female)
- RS-422 Connector: 4 screw terminals + ground

#C/MH 262 Optically-Isolated RS-232 to RS-422 Converter Module\$139

Circle 394 on Inquiry Card.

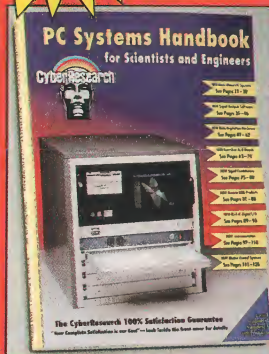


New PC Products for

FREE

PC Systems Handbook for Scientists & Engineers

*This Combination Tutorial/Catalog
Includes Many Examples of PC-based
Scientific & Engineering Systems*



Have you wanted to enjoy the many benefits of configuring your own PC-based Data Acquisition or Instrumentation system, but didn't know where to begin? The **PC Systems Handbook** will lead you every step of the way, explaining all aspects of systems configuration with easy-to-understand text and clearly documented diagrams. A detailed glossary and two dozen "Tech Notes" help you understand the

terminology. Our new **1993 Edition** will be expanded to 196 pages with a hard spine, making it suitable as a permanent addition to your bookshelf. And there is **absolutely no charge** for this invaluable reference book delivered within the United States. A handling charge is required for Handbooks sent overseas. Please call or Fax for information.

Topics Covered Include:

- Industrial Rack-Mount PC's — 80386, & 80486 Models
- Real-Time Data Acquisition, Analysis, & Process Control Software
- PC Plug-in Boards for Analog/Digital, Digital/Analog, & Digital I/O
- Connect your PC to Test Instrumentation with IEEE-488, RS-232, RS-422
- Stepping and Servo Motor Control with your Personal Computer

Circle 396 on Inquiry Card.

Notice to International Customers

You can buy direct from CyberResearch and **save 50% or more!** A majority of the leading brands of PC-based engineering products are available for export from CyberResearch at the same low prices as those enjoyed by our customers in the United States.

Due to contractual restrictions, products from some manufacturers are not available for export to certain countries.

Please fax a request for quotation listing brand and/or performance requirements, and we'll fax back a prompt response.

Circle 396 on Inquiry Card.

NEW Rack-Mount Computer Systems with Pull-out Keyboard & VGA Color Monitor

Rack Mtg PC w/Pull-out Keyboard

SAVE MONEY!



Select a Complete System Configuration

Utilize components from our extensive product line and we will install and test them **at no extra charge** at our world headquarters in Branford, CT before shipping the complete system to you.

High-Performance Rack-Mount PC's at Economical Desktop Prices!

Now you don't have to pay a huge premium to enjoy the benefits of a 19" rack-mountable PC.

Rugged Chassis Saves Rack Space

Many manufacturers would require you to use 10.5" of height for a PC, 14" for a monitor, and 3.5" for a keyboard drawer (on which you are supposed to balance the keyboard while you type.) This comes to 28" (16 rack units) of rack height. Our new VRK models include all of these components in just 10.5" (6 rack spaces) tall. You can fit 2 1/2 PC's in the space of their system, or simply have a rack-mount PC where it was never possible before.

VRK Rack-Mount PC's come in heavy-duty metal cases for EMI/RFI protection.

The VRK line includes the following features:

- Your choice of 80386 or '486 microprocessor. From affordable 386sx models to Ultimate-Performance 50MHz EISA-Bus Computers.
- 4MB of RAM (2MB on 386sx model).
- 10" VGA High-Resolution Color Monitor, with VGA Card included at no extra charge.
- Eight Expansion Slots.

- Industrial Keyboard pulls out and locks — does not move while typing. A protective door keeps keys safe from foreign materials when not in use.
- 1.2MB (5.25") or 1.44MB (3.5") Floppy Drive.
- 3 Full-access Drive Bays for Floppy Drives, etc.
- Hold-Down keeps Expansion Cards Firmly Seated.
- Floppy & IDE Hard Disk Controller Included.
- Dual-Fan Cooling System w/Honeycomb Filter.
- Rack-Mounting Slide Rails Included FREE.

#VRK 386-20S Rack-Mount 20MHz 80386sx PC w/VGA Monitor, Rack-Mount Keyboard, & 2MB RAM...**\$395**

#VRK 386-33 Rack-Mount 33MHz 80386 PC w/VGA Monitor, Rack-Mount Keyboard, & 4MB RAM...**\$395**

#VRK 486-33 Rack-Mount 33MHz 80486 PC w/VGA Monitor, Rack-Mount Keyboard, & 4MB RAM...**\$4195**

#VRK 486-50 Rack-Mount 50MHz 80486 PC w/VGA Monitor, Rack-Mount Keyboard, & 4MB RAM...**\$4495**

#VRK 486-50E Rack-Mount 50MHz EISA-Bus 80486 PC w/VGA Monitor, R-M Keyboard, & 16MB RAM...**\$5895**

Prices subject to change (reduction) at any time

Also available as chassis-only for installation of computer by others. Call or FAX for the latest pricing, quantity discounts, and more information on the entire VRK rack-mounting product line.

Circle 395 on Inquiry Card.

Scientists & Engineers

PC Products for Scientists & Engineers

When you need PC-compatible equipment for science and engineering, there's only one name to think of: **CyberResearch**. We offer the largest selection of hardware and software for data acquisition, instrumentation, communications, motion control, etc. We stock all your best-known suppliers like those featured on these pages and many more.

FREE Application Engineering

At CyberResearch we have no salespeople. Our engineers have one priority: to help you find the best technical solution to your problems. Calling our Applications Hotline is like having your own free consultant. Call and let our experience work for you.

100% Satisfaction Guarantee

You can order from CyberResearch with confidence. If you are not completely satisfied with your purchase, simply call our toll-free hotline within 30 days of receiving the item. A friendly customer service technician will arrange for a full refund, replacement, exchange, or credit. **No Problem. No Hassle.**

It's Easy to Order

We accept Purchase Orders from:

- Government Agencies
- Fortune 500 companies
- Universities & hospitals

Others may prepay by check or credit card. We also will ship COD with a company check.

©1992 CyberResearch, Inc.

CyberResearch



Mailing Address:
P. O. Box 9565
New Haven, CT 06535

Worldwide
(203) 483-8815
Fax: (203) 483-9024

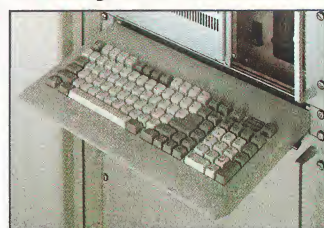


TOLL-FREE (800) 394-3300

Circle 396 on Inquiry Card.

Elma Rack-Mount Keyboards

If you use a standard keyboard with your rack-mount system, you know what a nuisance and a hazard it can be. These industrial keyboards are designed to fit easily into any EIA 19" rack. Rugged and reliable, these keyboards are made in the U.S.A. by a Swiss electronics company & demonstrate classic Swiss craftsmanship.



- 101-key layout & full-travel construction with tactile feel for touch-typing
- **#OIX 3010** drawer-mounted / **#OIX 6010** (shown) slides out with locking door
- Occupies only 1 rack space (1.75" high)

#OIX 3010 Low-cost, Drawer-Mounted Rack-Mount Keyboard.....**\$295**

#OIX 6010 Slide-out, Rack-Mount Keyboard w/locking drawer.....**\$395**

Circle 395 on Inquiry Card.

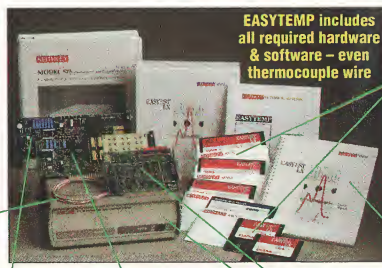
The EASYTEMP System from Keithley/Metrabyte

THE SYSTEM

A complete software & hardware solution, the Easy-Temp system can acquire 16-bit data at up to 50,000 samples per sec.

Hardware

Thermocouple wire included with each system.



Thermocouple Interface 16-Bit A/D & Control Module EasyTemp Hardware Chassis PC Interface Card

EASYTEMP includes all required hardware & software — even thermocouple wire

Software

New EASYTEMP LX software lets you start acquiring data immediately. Specialized start-up software is designed to provide powerful, application-specific solutions.

Manuals

Detailed manuals facilitate speedy set-up of your EasyTemp system.

#KDAC 575 EasyTemp Temperature Monitoring System w/Software.....**\$4450**

Circle 397 on Inquiry Card.

100 MHz PC-Based Oscilloscope

CompuScope 250 from Gage Applied Sciences is a family of high quality 100 MegaSPS PC/XT-compatible Data Acquisition Cards with advanced oscilloscope software. Features include:

- 100MHz sampling on 1 channel (10ns/sample) or 50MHz simultaneous sampling on 2 chan.
- 8-bit resolution
- 50MHz bandwidth
- 32 or 128-KiloByte memory buffer
- Software programmable input gains
- Store and load setups and signals
- Drivers available in C, Pascal and Basic.

#DSO 200 40MHz CompuScope Lite w/16K Buffer.....**\$595**

#DSO 250L 100 MHz CompuScope 250 Lite.....**\$2750**

#DSO 250-32 100 MHz Scope w/32K Buffer.....**\$3495**

#DSO 250-128 100 MHz Scope w/128K Buffer.....**\$3895**

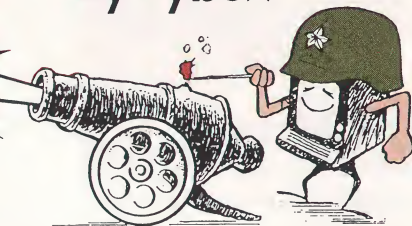
Circle 396 on Inquiry Card.



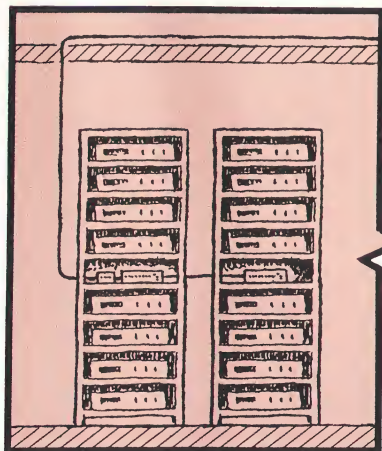
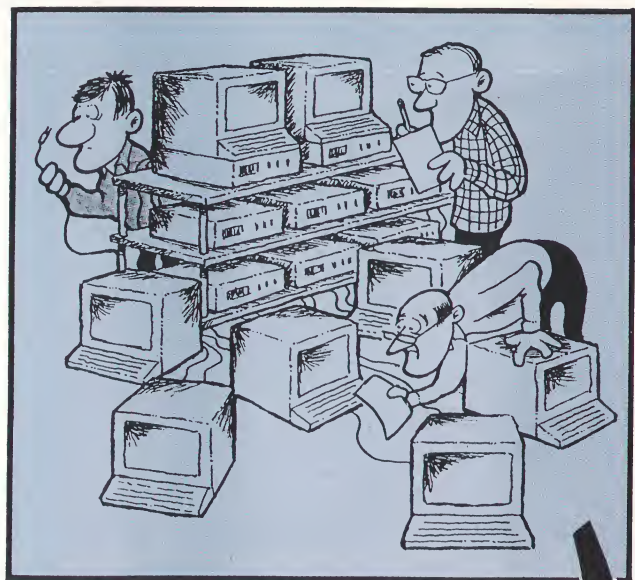
CONTROL UP TO **96** PC FILE SERVERS WITH **1** KEYBOARD AND MONITOR USING...

COMMANDER

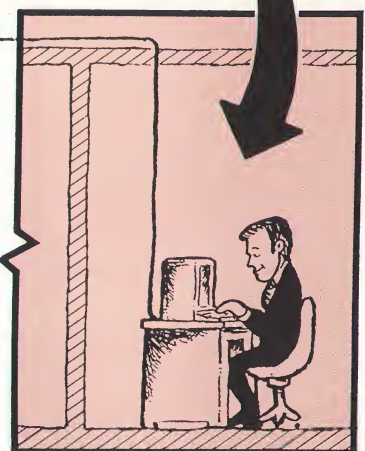
by cybex



- **Select via Keyboard**
- **Dual access up to 250 feet away (optional)**
- **No external power**
- **Mix PC, PC/XT, PC/AT and PS/2**
- **"AutoBoot™" Feature boots attached computers without operator intervention**
- **Shows PC power status**



- **PS/2 Mouse support available**
- **Each unit accommodates from 2 to 8 PCs**
- **Up to 12 units can be cascaded**
- **Mounting kit available for 19" and 24" rack installation**



Dealer Program Available

Cybex Corporation

2800-H Bob Wallace Ave.
Huntsville, Alabama 35805

(205) 534-0011

Fax (205) 534-0010

See us at

COMDEX/Fall '92

Booth # 4700

PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.

Become a legend before your own time.

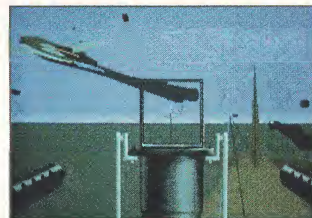
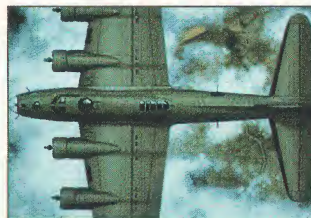


What becomes a legend most? Find out for yourself as you pilot the legendary **B-17 Flying Fortress** and lead a 10-man crew through the same flak-infested skies that menaced the legendary flyboys of the *Memphis Belle*.

The most complete and accurate bomber simulation ever produced, the **B-17 Flying Fortress** will have you negotiating 25 perilous daylight missions over Nazi-occupied Europe.

You'll allocate crew members to their specific tasks. You'll devastate strategic targets in dangerous bombing runs. You'll take control of crew positions from pilot to bombardier. And you'll even customize your own Flying Fortress with historically accurate nose art.

So pick up your copy of **B-17 Flying Fortress** today. And experience a flight simulation of legendary proportions.



Actual screens may vary.

MICRO PROSE™
ENTERTAINMENT • SOFTWARE

For IBM PC compatibles!

For more information about exciting MicroProse products,
call **1-800-879-PLAY**

© 1992 MicroProse Software, Inc. ALL RIGHTS RESERVED.



Largest inventory of memory available anywhere...and we won't be undersold!

COMPAQ Memory

MODEL	MEM	PART#	COST
Portable III	512K	107331-001	\$38
Portable III	INTFC	107808-001	99
Portable III	EXP BD	107811-001	249
Portable III	2MB	107332-001	98
Portable 386	1MB	107651-001	129
Portable 386	4MB EXP	107653-001	449
Portable 386	4MB DAGHT	107654-001	449
Deskpro 386/16	1-2MB	108069-001	299
Deskpro 386/16	2MB	108069W71	348
Deskpro 386/16	1MB	108071-001	114
Deskpro 386/16	4-8MB	108070-001	545
Deskpro 386/16	4MB	108072-001	249
Deskpro 286E; 386/20; 20E; 25; 25E	1MB	113131-001	59
Deskpro 286E; 386/20; 20E; 25; 25E	1MB	113132-001	158
Deskpro 386S/16	1MB	113646-001	72
Deskpro 386/20E; 25E	4MB	113645-001	208
Deskpro 386/33; 386/33; 486/25;	2MB	115144-001	102
33L; 50L; Systempro	8MB	116561-001	298
Systempro	8MB	116561-001	298
Deskpro 286N; 386N; 386SX/20; 20N;	1MB	118688-001	49
Portable 486c; Deskpro M; Systempro LT	2MB	118689-001	94
Series 129160-001	4MB	118690-001	148
Series 129160-001	8MB	128877-001	298

COMPAQ Laptop Memory

MODEL #	MEM	PART#	COST
Contura Notebook	2MB	139497-001	\$88
Contura Notebook	4MB	139498-001	148
Contura Notebook	8MB	139499-001	298
Compaq SLT/286	1MEG MOD	110235-001	99
Compaq SLT/286	4MEG MOD	110237-001	198
Compaq SLT/386	1MEG MOD	118303-001	129
Compaq SLT/386	2MEG MOD	118304-001	89
Compaq SLT/386	4MEG MOD	118305-001	199
Compaq Lite 286	1MEG BRD	117081-001	69
Compaq Lite 286	2MEG BRD	117081-002	99
Compaq Lite 286	4MEG BRD	117081-003	148
Compaq Lite 386/20	1MEG MOD	121125-001	78
Compaq Lite 386/20	4MEG MOD	121125-002	219
Compaq Lite/20; 25	2MEG MOD	129769-001	148
Compaq Lite/20; 25	4MEG MOD	129769-002	198
Compaq Lite/20; 25	8MEG MOD	129769-003	448

IBM PS/2 Memory

MODEL #	MEM	PART#	COST
PS/1 and 386/SX	2MB	92F9935	\$148
PS/2 140SX; N335X Laptop	2MB	79F0999	79
PS/2 140SX; N335X Laptop	4MB	79F1000	149
PS/2 140SX; N335X Laptop	8MB	79F1001	299
PS/2 30/286; Adpt Brd 1497259	512K	30F5348	39
PS/2 30/286; 25/286; Adpt Brd 1497259	2MB	30F5360	89
PS/2 355X; LS; 405X; 70-E61; 061; 121	1MB	6450603	49
Adpt Brd 6450609; 34F3011; 34F3077	2MB	6450604	78
Adpt Brd 6450609; 34F3011; 34F3077	2MB	6450608	89
XStation 120 & 130	4MB	34F2933	149
PS/2 355X; LS; 405X	8MB	6450129	298
ALL 70's and 80's	2-8MB	6450605	249
PS/2 80-A21; A31; A61	4MB	6451060	198
PS/2 80-041	1MB	6450375	68
PS/2 80-111; 311; 121; 321; 081; 161	2MB	6450379	104
PS/2 90; 95 (Install in pairs) P75; 56; 57	2MB	6450902	98
(all models) PS/1 Pro 386SX M2123	4MB	6450128	159
PS/2 90; 95; P75; 56; 57 (all models)	8MB	6450130	298
RS/6000 Powerstation/Powerserver 220	8MB	6450130	298

D-Ram Chips

DESCRIPTION	150NS	120NS	100NS	80NS	70NS	60NS
64 X 4	\$1.95	\$2.25	\$2.45	\$2.95		
256X1 STATIC				1.95	\$2.25	
256 X 1	.95	1.05	1.10	1.15	1.45	\$2.20
256 X 4		3.95	4.45	4.95	5.45	4.95
1MEG X 1		2.95	3.45	3.95	4.45	4.75
1MEGX1 STATIC				4.95	5.25	
1MEGX4				17.00		

Zenith Memory

486/33ET	4MB	ZA-4200-M2	\$198
486/33ET	16MB	ZA-4200-M8	598
Z-386/20; 25; 33; 33E	1MB	ZA-3600-ME	49
		ZA-3800-ME	
Z-386/20; 25; 33; 33E; 486/25E	4MB	ZA-3800-MK	148
Z-248; Z286LP; Z386SX	2MB	Z-605-1	98

TOSHIBA Laptop & Notebook Memory

MODEL	MEM	PART#	COST
T200SX/T1000 SE/LE/XE	1MB CARD	PA8311U	\$68
T200SX/T1000 SE/LE/XE	2MB CARD	PA8312U	108
T200SX/T1000 LE	4MB CARD	PA8314U	168
T200SX/T1000 LE	8MB CARD	PA8315U	298
T1200 XE	2MB BRD	PA8306U	98
T1600	2MB BRD	PA8302U	78
T2000 SXE	2MB CARD	PA2000U	108
T2200	4MB CARD	PA2001U	168
T2200	8MB CARD	PA2002U	328
T3100 E	2MB MOD	PA8341U	88
T3100 SX	2MB BRD	PA8308U	88
T3100 SX	4MB BRD	PA8310U	138
T3200 SX	2MB MOD	PA8307U	88
T3200 SX	4MB MOD	PA8309U	138
T3200 SXC	2MB MOD	PA8318U	88
T3200 SXC	4MB MOD	PA8319U	148
T3200	3MB BRD	PA7137U	148
T3300 SL	2MB CRD	PA2006U	118
T3300 SL	4MB CRD	PA2007U	148
T3300 SL	6MB CRD	PA2008U	235
T3300 SL	8MB CRD	PA2009U	895
T4400 SX (SXC) (T6400 SXC DXC)	2MB CRD	PA2003U	115
T4400 SX (SXC) (T6400 SXC DXC)	4MB CRD	PA2004U	214
T4400 SX (SXC) (T6400 SXC DXC)	8MB CRD	PA2005U	375
T4400 SX (SXC) (T6400 SXC DXC)	16MB CRD	PA2010U	745
T5100	2MB BRD	PA8301U	78
T5200/T5200C/T8500	2MB MOD	PA8304U	98
T5200/T5200C/T8500	8MB MOD	PA8313U	298

NEC Memory

MODEL	MEM	PART#	COST
Powermate 386/33i	16MB MOD	OP-410-6206	\$695
Express Te Series	2MB MOD	OP-41-5101	195
Powermate 386/33E;	2MB MOD	APC-H751X	295
486/25E	2MB MOD	APC-H750J	295
Powermate Portable SX	2MB MOD	APC-H750J+751	295
Powermate Portable SX	8MB MOD	APC-H750J+2 (751)	395
Portable Plus	1-3MB BRD	PC-22-21	148
Portable Plus	2-3MB BRD	PC-22-22	203
Portable Plus	4MB BRD	PC-44-21	245
Ultralite 286F	1MB MOD	PC-44-22	674
Ultralite 286F	4MB MOD	PC-47-21	119
Ultralite SX/20	2MB MOD	PC-47-22	119
Ultralite SX/20	8MB MOD	PC-47-23	799
Ultralite III SL20 & 20P	2MB MOD	PC-43-22	365
Ultralite III SL20 & 20P	6MB MOD	PC-21-21	118
Ultralite III SL25C	2MB MOD	PC-21-26	219
Ultralite III SL25C	4MB MOD	PC-21-21	395
Ultralite III SL25C	8MB MOD	PC-31-21	158
Prospect SX20	1MB BRD	PC-31-22	568
Prospect SX20	4MB BRD		
Prospect 286; 386SX/16	1MB CRD		
Prospect 286; 386SX/16	2MB CRD		
Prospect 286; 386SX/16	4MB CRD		
Prospect 386	2MB CRD		
Prospect 386	8MB CRD		

Simm Modules

DESCRIPTION	100NS	80NS	70NS	60NS
256X9	\$9	\$10	\$11	
1MEGX3	27	28	30	34
1MEGX 9	29	32	34	37
4MEGX 9		109	119	129
256X36 1MEG (72 Pin)		50		
512X36 2MEG		85		
1X36 4MEG		139	159	169
2X36 8MEG		299	309	319
4X36 16MEG		499	539	579

Laser Printer Memory

	1 MEG	2 MEG	4 MEG
Brother HL	\$99	\$149	\$249
Canon LBP4	128	178	
Epson Action Laser II		149	199
Epson 6000; Action LSR		109	178
Fujitsu 7100 & 7200		199	299
HP Deskjet 500; 500C	64 (256K)		
HP2; 2D; 3; 3D; 3P; 2P; 2P+		99	159
HP III SI		49	149
IBM Laser 4019; 4019E		149	149
IBM Laser 4029		149	149
Konica LP3110/3115	98	149	
NEC 90; 290		118	
NEC 95		138	
OKI 400		108	
Packard Bell PB9500	108	125	168
Panasonic 4410/4430		128	198
Panasonic 4420/44501	89	118	198
Panasonic 4450	119		
Panasonic 4455		139	
QMS 410	109	149	249
Star LS04	129	179	269
StarScript 4	128	178	258
Toshiba Page Laser 6		109	168
TI	79	149	299
TI XL/PS17/PS35	59		

AST Desktop & Notebook

MODEL	MEM	PART#	COST
Exec Notebk 286; 386SX/20	1MB	500814-001	\$48
Exec Notebk 286; 386sx/20; 25; 25C	4MB	500814-003	138
Bravo 4/33; 486/25; Prem II	2MB KIT WPB	500718-004	88
Prem II (all models)			
cUPID-32 (500818-001;			
500722-004)			
Prem 386/25; /33;/33T;			
386SX/16	1MB WPB	500780-003	48
Prem II (all models)			
Prem 386/33T; 386SX/16			
Cupid-32 (500818-001)	4MB WPB	500780-004	148
Prem 486/33; Bravo 486/25; 4/33			
Prem 386/33T; 486/25 all models			
Prem 486/25T; /33T; 386/33T			
Prem II (all models)	8MB KIT	500780-001	288

HEWLETT PACKARD Vectra Memory

MODEL	MEM	PART#	COST
486 PC; 486/25T; 33T (install in pairs)			
cUPID-32 (500818-001)	1MB	D2150A	\$68
486PC; 486/25T; 33T (install in pairs)			
386/25 PC; 486/20PC	2MB	D2381A	98
486 PC; 486/25T; 33T (install in pairs)			
486S/20 PC	4MB	D2151A	168
486S/20; 486PC; 25T; 33T (install in pairs)	8MB	D2152A	298

Sun Micro Systems

MODEL	MEM	PART#	COST
Sparcstation ELC	4MB MOD	X104Q	\$179
ELC; IPX; 3/60;80; 4/40;40;65	16MB MOD	X116Q & U	595
Sparc 1	4MB KIT	X104C,G,H,Y	298
Sparc SLCA/20	4MB SIM	X105Z	198
Sparcserver 630 & 670MP; 690	64MB KIT	X168A	2495
4/110	16MB KIT	X116D	645
Sparc 11; 4/40;60; 65			
4/75; 4/330;4/370; 4/390	16MB KIT	X116H,Y,WD	645
4/330; 4/370; 4/390	8MB KIT	X108E	445
4/330; 4/370; 4/390	32MB KIT	N/A	1195

More Laptop Memory

MODEL	MEM	PART#	COST
ALR Ventura 16 & 17	1MB	12407980	\$198
ALR Ventura 16 & 17	4MB	12407970	895
AT&T Safari	2MB	37650	148
AT&T Safari	4MB	37651	288
Bondwell B-310	1MB	23050-09100	108
Everex Tempo LX; LX20	2MB	00160	88
Everex Carrier	2MB	00263-00	114
Epson NB3	4MB	A808511	178
Commodore	2MB	390850-01	87
Grid 1500; 1450SX	4MB	52587	189
Grid 1500; 1450SX	2MB	6200203	209
Goldstar GS520; 386SX16	1MB	N/A	98
Goldstar GS520; 386SX16	4MB	N/A	248
Packard Bell; Magnavox; Mitsuba	1MB	N/A	98
Packard Bell; Magnavox; Mitsuba	2MB	N/A	148
Packard Bell; Magnavox; Mitsuba	4MB	N/A	218
Samsung Nolemaster 386S	2MB	SNM002	195
Samsung Nolemaster 386S	4MB	SNM004	395
Sanyo 17NB; 18NB	2MB	MBE-NBME12	195
Sharp 6220	1MB	CE-621B	108
Sharp 6640	2MB	N/A	248
Sharp 4700MZ-200	1MB	CE-471	198
Sharp 8501 Colorstar	2MB	N/A	398
Tandon NBE86SX	1MB	N/A	88
Tandon NBE86SX	4MB	N/A	299
TI Travelmate 2000; 300	1MB	N/A	68
TI Travelmate 2000; 300	2MB	N/A	88

BOCA Memory Boards

Boca AT Plus (Brat 90 uses 1MEG Simms) OK-BMEG Board, 4.0 LIM compatible, Conventional, Expanded & Extended Memory, Supports DOS, OS/2, UM/EMS & EEMS
OK \$94, 2MEG-\$159, 4MEG-\$249, 8MEG-\$369
Brat 80 (uses 1MEG Simms) \$79
Brat AT + I/O ParSer 0-4MEG \$118
Bocaram-2 Plus for PS/2 16 Bit Memory for all IBM/MCA Systems, DOS & OS/2 LIM EMS 4.0 Support. 2-8MB (uses 1MB Simms) . 2 MB-\$179, 4MB-\$279, 8MB-\$399

COMPUTER PERIPHERALS INC. Memory Boards

For 286 and 386's, 16 Bit, 2MB Expandable to 4MB. (Uses 1MB x 1D

Convenience: Same day shipping, Corporate Accounts, large inventory and we accept International Orders!
Safety: We've been in business for 6 years, we offer a 15 day money back guarantee & we're Nevada's largest computer wholesaler
Savings: We have buying power, we have no surcharges, and we offer toll free calling.

Wordstar 6.0 or Wordstar 2000 Rel. 3.5



This is not a misprint! These are the exact same ones selling for over \$300.00 from our competitors.

We have thousands in stock FOR SALE BELOW DISTRIBUTOR COST!

\$99

LIST \$495.00 ea

DEALERS WELCOME
RETAIL BOXED & FACTORY SEALED

\$99

LOTUS 123 Version 3.1

Due to a large OEM excess we are offering Lotus 123 version 3.1 with original manual, 3.5" disks in sealed bags with original registration cards

only \$199

CD ROM Drives

MAKE	TYPE	SIZE	SPEED	COST
Magnavox	External	757MB	700MS	\$299
Magnavox	Internal	680MB	375MS	379
Chinon	External	600MB	350MS	499
Chinon	Internal	600MB	350MS	369
Toshiba	External	683MB	325MS	549
Toshiba	Internal	683MB	325MS	429

All CD Rom's come complete with software interface and documentation.

Sound Cards

Sound Blaster	94
Sound Blaster Pro	188

FONT CARTRIDGES FOR HP & COMPATIBLES

COMPUTER PERIPHERALS, INC.

Action Set- 102 fonts, same as HP's Pro Collection, compatible with HP, Epson etc. \$89
Super Set- 25 fonts, comparable to Pacific Data 25 in 1, HP's Pro Collection and HP's Microsoft. \$199
Desk Set- 118 fonts for HP 500, 500C, 5 to 30pt. \$114
Jet Page- postscript for HP \$199

Seagate Special's IBM

Seagate/IMPIMIS Hard Drives
 660MB, SCSI, 15.5MS, 5.25" FH, #ST4766N \$999
 1037MB, SCSI, 15MS, 5.25" FH, #ST41200N \$1699
IBM XT Compatible Computer
 8088 XT 10MHz w/640K memory, 40MB hard drive, 360K floppy, Parallel, Serial, Clock, 12" Amber monitor, 101 Key Keyboard, 6 Month Warranty. \$349

MITSUBISHI Monitors

6605	16" D'md Scan, Non-Int.	.28	1280X1024	999
6705	17" D'md Pro, Flat, Non-Int.	.26	1280X1024	1249
7955	20" D'md Pro, Non-Int.	.31	1280X1024	2284
3925	20" D'md Scan LP	.31	1024X768	1764
6115	21" D'md Scan, Flat, Non-Int.	.31	1280X1024	2987
3505	26" D'md Pro, Non-Int.	.31	1280X1024	6985

OTHER 14" S VGA Other .28 1024X768 \$259

CPU Upgrades Kingston Technologies

Turn your 286 into a 386! True multitasking, background operation for Windows 3.0, OS/2 and 386 software. SX/NOW improves system performance by up to 350%. Available for: HP ES286/12 & ES 8, EPSON EQUITY IIe & II+, IBM ORIGINAL AT & XT/286, AGI 1800A, 1800B & 1800C, ASTPREMIUM286, BRAVO 286, COMPAGQ PORTABLE III, DESKPRO 286, NEC POWERMATE 286+ & PORTABLE+, IBM PS/2, 25/286, 30/286, 50, 50Z, 60.

20MHz SX/NOW \$299
25MHz SX/NOW \$349

intel Coprocessors

MODEL	80386 BASED MACHINES:	80387
8088 BASED MACHINES:	80287 6MHz \$29	80387 20MHz \$59
8087 3.5MHz \$49	80287 8MHz \$39	80387 25MHz \$69
8087 2.5MHz \$69	80287 10MHz \$49	80387 33MHz \$79
8087 1.5MHz \$99	80287 16MHz \$84	80387 SX16 \$79
	80287 XL \$99	80387 SX20 \$89
	80287 XLT \$99	80487 SX20 \$399

Overdrives
 80486 SX16/SX20 \$499
 8046 SX25 \$599

5 YEAR WARRANTY, WE'LL NEVER BE UNDERSOLD!

COMPUTER PERIPHERALS, INC. Modems BOCA

2400 Internal, 1/2 Card for IBM PC, XT, AT and compatibles. CCITT V.22bis, V.22 and Bell 212A, Auto dial/Auto answer. Supports Comm 1-4/IRQ 2-5, Software included \$39

2400 External, same as above plus 8 LED status lights, requires serial port \$69

HIGH SPEED FAX MODEM 14.4K bps, V32bis, Internal \$239

BOCA 2400 Internal, V.42bis w/MNDS \$89

BOCA RESEARCH FAX MODEM 9600bps Fax, 2400bps modem, Data Fax Auto Sensing, COM 1-4 IRQ 3,4,5 or 7, Hayes "AT Commands", Mirror Software, Full or half Duplex, Pulse or Tone 888

Video Boards

MONO	Hercules Comp w/pa-port	\$14
VGA	800X600 w/256K	29
VGA	800X600 w/512K	49
SVGA	1024X768 w/256K	39
SVGA	1024X768 w/512K	59
SVGA	1024X768 w/1MEG	74
Orchid Fahrenheit W/1MB	1280X1024 w/1MEG	259

intel CPU's intel

TYPE	MODEL	COST
386SX	80386 SX/16	\$29
386SX	80386 SX20	39
386SX	80386 SX/25	49
386SX	80386 SX/33	59
386DX	80386 DX/20	49
386DX	80386 DX/25	71
386DX	80386 DX/33	81
486DX	80486 DX/25	295
486DX	80486 DX/33	339
486DX	80486 DX/50	549
486DX	80486 DX-2/50	499
486DX	80486 DX-2/66	999

This is just a sample of what we

have in stock! We will never be undersold on price, quality or service! Call today!

MITSUBISHI Floppy Drives

360K	5.25"	1/2 HT	29
720K	5.25"	1/2 HT	29
1.2MB	5.25"	1/2 HT	58
1.44MB	5.25"	1/2 HT	58
	5.25"	MOUNTING	5

Maxtor Hard Drives

MODEL	SIZE	SPEED	TYPE	COST
7213A	213MB	15MS	IDE	399
7080A	80MB	17MS	IDE	249
7120A	120MB	17MS	IDE	319
DX340A	340MB	15MS	IDE	799
DX340S	340MB	15MS	SCSI	899
7213S	213MB	15MS	SCSI	499

CONNER Hard Drives

MODEL	SIZE	SPEED	TYPE	COST
CP3000	40MB	19MS	IDE	189
CP30084E	80MB	19MS	IDE	249
CP30104A	120MB	19MS	IDE	309
CP3204F	200MB	15MS	IDE	479
CP3544A	525MB	15MS	IDE	1045
CP30100S	120MB	19MS	SCSI	399

Popular Hard Drives

MODEL	SIZE	SPEED	TYPE	COST
QUAN LPS425	42MB	17MS	SCSI	227
QUAN LPS52A	52MB	17MS	IDE	249
QUAN LPS584A	80MB	17MS	IDE	299
WD AC280	80MB	17MS	IDE	249
QUAN LPS1055	105MB	17MS	SCSI	319
QUAN LPS105A	105MB	17MS	IDE	349
WD AC2120	120MB	17MS	IDE	309
QUAN LPS240	240MB	17MS	SCSI	675
MIC M1578	340MB	15MS	SCSI	1095
MIC MC1684-7	340MB	15MS	ESDI	1049
FUJ M2624T	513MB	14MS	IDE	1095

Seagate Hard Drives

MODEL	SIZE	SPEED	TYPE	COST
ST225	20MB	65MS	MFM 5.25"	149
ST4096	80MB	28MB	MFM Full HT	349
ST277R-1	60MB	21MS	MFM 5.25"	219
ST351A	40MB	28MS	IDE 3.25"	179
ST3120A	105MB	19MS	IDE 3.25"	269
ST1239A	210MB	19MS	IDE 3.25"	488
ST1480N	426MB	14MS	SCSI 3.25"	999

Cyrix Coprocessors

CYRIX	83D87-33MHz	88
CYRIX	83D87-40MHz	118
CYRIX	83D87-SX/25MHz	78
AMD	80C287-10MHz	34
AMD	80C287-12MHz	58
WEITEK	3167-20MHz	89
WEITEK	3167-25MHz	168
WEITEK	3167-33MHz	239
WEITEK	4167-25MHz	349
WEITEK	4167-33MHz	499

Drive Controllers

8Bit	2 Floppy w/Cables	9
8 Bit	4 Floppy High Density (1.2, 1.44, 720, 360K)	49
8 Bit	2 Hard Drives MFM	49
8 Bit	2 Hard Drives RLL	59
16 Bit	Hard only	24
16 Bit	Hard and Floppy 1.1	34
SCSI	DTC-3280 (Supports 7 drives)	139
ESDI	DTC6282-24	149
IDE	Hard and Floppy	29
IDE	Hard and Floppy w/IO	39
Cables	Hard Drive	9
Cables	Hard and Floppy	14

ORDERS ONLY

800-982-2925

TECHNICAL/CUSTOMER SERVICE/ORDER STATUS:

(702) 294-0204 FAX (702) 294-1168

FAX ORDERS WELCOME

WE PURCHASE EXCESS INVENTORY! CALL OR FAX LIST

Mfg. part #'s for convenience only. Most memory products 3rd party. International orders shipped DHL or Air Mail. Trademarks are registered with their respective Co.'s. 386, 387, 287, SX, one trademarks of Intel Corp.

CONDITIONS: 20% Restocking Fee on refunds within 30 days. No refunds or exchanges after 30 days. WARRANTY REPLACEMENT ONLY. ALL PRICES FINAL. PRICES SUBJECT TO CHANGE

TERMS: NO SURCHARGE FOR MC/VISA/AE SHIPPING: UPS (Min. \$8.25) Shipping charges are non-refundable. NET 30 Accepted. Purchase orders from Universities, Fortune 1000 & Government Agencies/Personal Checks, COD add \$5.00 (Cashiers check required). Best prices on some items under some terms. WE ACCEPT INTERNATIONAL ORDERS



AD # B1192

684 Wells Road
Boulder City, NV
89005



MEMORY AND MORE...

30 Day
Money Back Guarantee
Buy with confidence!

First Source International
"The Only Source for Computer Upgrades"

- 30 Day Money Back Guarantee
- 100% compatible in form, fit, and function
- User installable products
- Installation instructions included
- Toll-free technical support
- Thousands of items in stock
- Manufacturer's warranties
- Corporate PO's, APO/FPO's
- Government & Educational pricing
- International orders welcome
- Special volume pricing
- 24-hour fax line
- Same day shipping
- Overnight delivery available



• Visa, MC, AMEX, and Discover accepted

• No surcharge on credit cards

• Call for any items not listed

• We'll meet or beat any advertised price

Toll free from anywhere
in the United States or Canada

800/535-5892

International

714/588-9866

Facsimile

714/588-9872

Business Hours

Monday-Friday, 8AM-5PM

Saturday, 10AM-3PM, P.S.T.



Mail orders to: First Source International
36 Argonaut, Suite 140
Aliso Viejo, California 92656 USA

Terms and Conditions

Memory products are third party, manufacturers part numbers are for your convenience. Freight charges are non-refundable. A 20% restocking fee will be charged on all non-defective returns, unopened, and returned or cancelled orders. Items must be returned within 15 days with original documentation and packaging. A Returned Merchandise Authorization number is required. Prices and availability are subject to change without notice. Purchase prices at the time of order are final. First Source International cannot be responsible for errors in typography or photography. We will beat any advertised price valid only on identical brands, offer not good for SIMMs or DRAM. Trademarks and registered trademarks are of their respective companies.

Kingston TECHNOLOGY CORPORATION

Turn your 286 into a 386 with the SX/Now!

For Windows enhanced mode, true multitasking, background operation for Windows 3.1, OS/2, and 386 software. SX/Now! Includes a Math coprocessor socket, 8Kb cache and improves system performance by up to 350%.

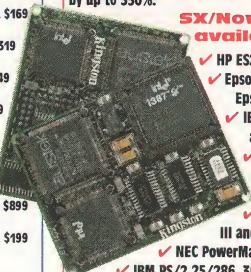
SX/Now! is now available for:

- ✓ HP ES286/12 & ES/8
- ✓ Epson Equity IIE and Epson Equity IIP
- ✓ IBM Original AT and XT/286
- ✓ AGI 1800A, B, C
- ✓ AST Premium 286 and Bravo 286
- ✓ Compaq Portable III and DeskPro 286
- ✓ NEC PowerMate 286+/ Portable+
- ✓ IBM PS/2 25/286, 30286, 50, 50Z, & 60

"Kingston Technology Corp.'s SX-Now! is the undisputed performance champ."

-PC Magazine, Oct 29, 1991

20MHz SX/Now!\$309
25MHz SX/Now!\$359
33MHz SX/Now!\$399



Personal Computer Memory

IBM

PS/1 286, 386SX	
2MB 92F9955	\$99
PS/2 30/286, Expansion board 1497259	
2MB KIT 30F5360	\$89
PS/2 35SX; 15, 40SX, 50Z, 55SX; 15, 65SX; 15, 70 & Xstation	
1MB 6450603 \$49 2MB 6450604	\$79
PS/2 70-821; A61; 821; 861	
2MB 6450608	\$79
PS/2 35SX; 15, 40SX, 55SX; 15, 65SX; 15, 34F300X & Xstation	
4MB 34F2933 or 87F9977	\$149
PS/2 35SX; 15, 40SX	
8MB 6450129	\$309
PS/2 90, 95, and P75 (Install in pairs)	
4MB 6450128 \$149 8MB 6450130	\$309
Expansion boards for 50Z, 50Z, 55SX, 60, 65SX	
2-8MB with 2MB 1497259	\$269
2-16MB with 2MB 6450609	\$309
Expansion boards for all models 70 and 80	
2-14MB with 2MB 34F3077	\$329

Compaq

ProLinea 3/25; 3/25Z	
2MB 141738-001 \$90 8MB 141742-001	\$285
DeskPro 386-20, 20E and 25	
4MB Module 115132-001	\$169
4MB Board 115645-001	\$239
DeskPro 386S/16	
4MB Module 112534-001	\$169
4MB Board 115634-001	\$249
DeskPro 286N, 386N; I Series; 386SX/20, 20N; Portable 486; II Series expansion boards; SystemPro LT Series	
1MB 116868-001 \$49 2MB 116869-001	\$79
4MB 116890-001 \$149 8MB 112877-001	\$309
DeskPro 386-33, 486-33, and SystemPro	
2MB 115144-001 \$109 8MB 116561-001	\$299
DeskPro 386N, 486N, SystemPro LT (32-bit Exp. board)	
2-64MB w/2M 129160-001	\$359

Zenith

Zenith Z-386/20; 25; 33 and 35E	
1MB ZAS300ME \$49 4MB ZAS300MK	\$149
Zenith Z-386SX, 286PL+, Z-LS	
2MB KIT Z-605-1	\$99
Zenith 486/33ET; 25E	
4MB ZAA200W2 \$189 16MB ZAA200W8	\$599

Hewlett-Packard

Vectra 05/16S; 20PC, RS/20PC; 25PC, 20C	
4MB KIT D1542A or D1642A	\$169
Vectra 386/16N, 386/20N	
2MB D2406A \$99 8MB D2404A	\$319
Vectra 486 PC (Install in pairs)	
4MB D2151A \$169 8MB D2152A	\$349
Vectra 386/25, 486/25T, 33T (Install in pairs)	
2MB D2381A	\$99

NEC

Powermate 286/12; SX/16 and SX/20	
2MB KIT OP-410-8103	\$99
Powermate 386/20; 25	
2MB APC-H655 \$329 8MB APC-H656	\$899
Powermate 386/33E and 486/25E	
2MB OP-410-5101	\$199

AST

Bravo 386-SX, WS/286, 386	
2MB 500510-002 \$89 4MB 500510-008	\$179
Premium 386/25; 33; 33T, Premium II 386SX/16; 20	
1MB w/WPB 500780-005; 002	\$59
Bravo 4/33; 486/25; Premium II; TE; Server SE 4/33	
2MB w/WPB 500718-004; 780-005	\$129
Premium II (All), Premium 386/33T and 386SX/16	
4MB w/WPB 500780-004	\$149
All Premium 386/33T, 486/33T, Server SE 4/33, Bravo 486	
8MB w/WPB 500780-001	\$289

Please call for any upgrade not listed.

Laptop & Notebook Memory

AST

Premium Exec Notebook	1MB\$69
4MB	\$129

Compaq

Contura 3/20 and 3/25	4MB\$199
	8MB\$429
LTE 286 Notebook	2MB\$109
	4MB\$199
LTE 386S/20 Notebook	1MB\$99
	4MB\$209
LTE Lite 20; 25 Notebook	2MB\$149
	4MB\$259
SLT 386 Notebook	1MB\$89
	4MB\$199

Dell

HL20 and HL25 Notebook	2MB\$179
Z12N and 320N Laptop	1MB\$89
Z12N and 320N; N+	2MB\$129

Everex

Tempo LX Notebook	2MB\$99
Tempo Carrier Notebook	2MB\$119

IBM

PS/2 CL57SX Color Notebook	4MB\$349
	8MB\$669
NS1 Notebook (All)	2MB\$179
	4MB\$249
LA05X and N33SX Laptop	4MB\$149
LA05X	8MB\$299

NEC

UltraLite III, SL/25C	2MB\$179
	4MB\$259
UltraLite SL/20, SL/20P	2MB\$179
	6MB\$329
ProSpeed 286, 386SX-16	1MB\$109
	4MB\$299
ProSpeed 386	2MB\$149
	8MB\$449

Texas Instruments

TravelMate 2000	1MB\$109
TravelMate 3000, WinSX	2MB\$89
TravelMate 4000	4MB\$219

Toshiba

T1000SE; LE; XE, 2000SX; SXe, 2200SX	2MB\$99
	4MB\$169
	8MB\$329
T1200XE, 1600, and 3100E	2MB\$95
T3100SX, 3200SX, and SXC Portables	2MB\$95
	4MB\$149
T3200	3MB\$159
T3300SL Notebook	2MB\$159
	4MB\$219
T4400 and T6400, SX, SXC Notebook	2MB\$149
	4MB\$219
	8MB\$449
T5100	2MB\$99
T5200; T5200C and T8500	2MB\$99
	8MB\$299

Zenith

Z-Note Notebook	2MB\$169
	8MB\$499
MastersPort 386SL, SLc, S1c	2MB\$109
MastersPort 386SX	2MB\$119
SupersPort SX; 286c; SilmsPort	2MB\$159
SupersPort 286; 286c	1MB\$99
SupersPort 286c; SilmsPort	4MB\$279
TurboPort 386; 386c	1MB\$89

Other Upgrades

Grid 4650SX	2MB\$149
Grid 1500 Series	4MB\$229
Panasonic CF70, CF270, CF370	1MB\$59
Sanyo and Zeos Notebook Memory	2MB\$99
Magnavox and Packard Bell Notebook	1MB\$99
	4MB\$209
Sharp G220 Notebook	1MB\$109

We now carry batteries for most notebook and laptop systems.

Laser Printer Memory

Hewlett-Packard LaserJet IIP, III, IIIP, IID	
2MB 334758 \$99 4MB 334778	\$159
Hewlett-Packard LaserJet II and IID	
2MB 334448 \$102 4MB 334458	\$160
Hewlett-Packard LaserJet IIISI	
1MB C2063A \$49 4MB C2065A	\$149
Hewlett-Packard DeskJet 500, 500C	
256K 220778	\$59
IBM Laser 4029 All Models	
2MB 1183334 \$109 4MB 1183335	\$149
Canon LBP-4	
1MB 563-2230 \$119 2MB PN N/A	\$169
Canon LBP-III and IIIi Plus	
2MB 563-2350 \$249 3MB 563-2360	\$299
Brother HL-8, 8E, 8D, 8V	
1MB MB-910 \$129 2MB MB-820	\$169
Panasonic 4410 and 4430	
2MB IX-P441 \$129 4MB PN N/A	\$199
Panasonic 44501 and 4420	
2MB IX-P441 \$119 4MB PN N/A	\$199
Okilaser 400	
1MB 7004701 \$79 2MB OKI PN N/A	\$99
Texas Instruments MicroLaser and XL	
1MB 2555739-0001	\$49
Epson EPL 6000	
2MB 185401 \$99 4MB PN N/A	\$169
Epson ActionLaser II, EPL-8000	
2MB PN N/A \$169 4MB PN N/A	\$259

Megahertz CORPORATION

Internal FAX/Modems for
AST, Compaq, IBM, Sharp, TI,
Toshiba, and Zenith laptops.

9600 FAX/9600 Modem
V.32 Modem with V.42/V.42bis
Throughput up to 38,400 bps\$549

Megahertz modems include:

- Easy installation with Illustrated user's guide
- Software included
- Free technical support
- Full 5-year warranty
- Hayes compatible

Internal Modems

2400bps w/V.42bis MNP-5\$179
Internal FAX/Modems with Send & Receive	
24/9600bps w/V.42bis MNP-5\$299
96/9600bps w/V.42bis MNP-5\$549

For all Laptop and Notebook computers

Pocket FAX/Modem with Send & Receive
24/9600bps w/V.42bis MNP-5 Send/Rec Fax\$279

BOCA RESEARCH INC.

Expansion Boards

BocaRam XT 512K-2MB for XT and PS/2 25/286 and 30/286 machines. Provides LHM 4.0 expanded memory only.	
W/512K	\$129
W/1MB	\$162
BocaRam AT Plus 2-8MB memory board for 80286 & 80386 IBM compatible machines running up to 33MHz. Get conventional, expanded (LHM EMS 4.0) and/or extended memory, supports OS/2.	
W/2MB	\$189
W/4MB	\$249
BocaRam AT I/O Plus 2-4MB memory board, same as AT Plus with 1 serial and 1 parallel port. Uses 1M x 1 DRAM chips.	
W/2MB	\$199
W/4MB	\$279

Video Cards

Boca Research	
Basic VGA (256K) 640x480 16 color\$65
Super VGA (512K) 1024x768 16 color\$119
Super X VGA 1MB 1024x768 256 color\$159

Diamond Computer

Stealth 24 24 bit, 16.7 million colors\$209
SpeedSTAR 24X True Color Card\$169

CALL THE UPGRADE EXPERTS TOLL FREE 800-535-5892

The Ultimate Power Platforms.

For 486 Windows and CAD - Comtrade's EISA or Local Bus.

486 EISA Win-Station

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Expandable to 128MB
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 2-Bit EISA Hard Disk Controller (350% faster DTR)
- 130MB 15ms IDE Drive with 64K Cache
- Diamond 24X Graphics Accelerator w/ 1MB VRAM (Up to 1280x1024 & up to 16.7 Million Colors) (Up to 30 times faster than standard super VGA)
- 14" Non-Interlaced .28mm SVGA Color Monitor
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX \$2145

486/50 DX2 \$2295

486/50 DX \$2395

486/66 DX2 \$2645

8MB RAM & 210MB Drive Upgrade Add \$300
15" Flat Screen 1280x1024 Monitor Add \$190

Local Bus Win-Station

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 130MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus Viper S3 Graphics Accelerator 1MB RAM (Up to 1280x1024 & up to 32K Colors) (Up to 50 times faster than standard super VGA)
- 14" Non-Interlaced .28mm SVGA Color Monitor (VESA Standard for 72Hz Flicker-Free Display)
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX \$1875

486/50 DX \$2175

8MB RAM & 210MB Drive Add \$300
32-Bit Local Bus Hard Disk Controller Add \$50

Local Bus CAD-Station

- 64K Super Fast Write-Back Cache SRAM
- 8MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 210MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus Viper S3 Graphics Accelerator 1MB RAM (Up to 1280x1024 & up to 32K Colors) (Up to 50 times faster than standard super VGA)
- AutoCAD Display List Driver
- 17" Flat Screen 1280x1024 SVGA Monitor
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX \$2745

486/50 DX \$3045

Above System with 12"x12" Digitizer Add \$320
32-Bit Local Bus Hard Disk Controller Add \$50



W

HEN IT COMES TO HIGH-SPEED EISA PERFORMANCE, COMTRADE IS FURIOUSLY BLOWING AWAY THE COMPETITION. "A VERY SWIFT GRAPHICS MACHINE," SAYS COMPUTER SHOPPER (MAY 1992). AND THIS HURRICANE EISA POWER IS FINALLY AVAILABLE TO YOU AT A PRICE THAT WON'T BLOW YOU AWAY. THESE EISA SYSTEMS FEATURE A POWERFUL 32-BIT EISA HARD DISK CONTROLLER THAT PROVIDES REAL 32-BIT ACCESS TO THE HARD DRIVE. THE RESULT IS A 350% FASTER DATA TRANSFER RATE (DTR). COMTRADE 486 EISA SYSTEMS - THE ULTIMATE MACHINE THAT LETS YOU TAKE YOUR WORKLOAD BY STORM.

"Performance is the
Comtrade's strong point."
"Excellent Design"

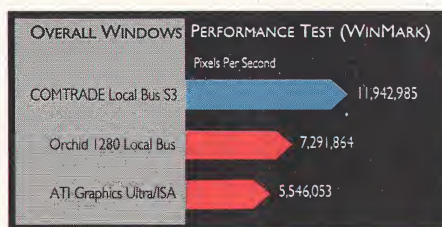


"The Comtrade 486 EISA
Win Station already has the
performance issue licked."

Comtrade Local Bus Wins Big!

In Comparison With Other Leading High Performance Super VGA.

INTRODUCING COMTRADE'S 32-BIT LOCAL BUS. TRADITIONALLY, 486 ISA MACHINES COULD ONLY SUPPORT 16-BIT VIDEO CARDS AND RUN AT STANDARD 8MHZ BUS SPEED. THAT WOULD RESULT IN A BOTTLENECK REGARDLESS OF HOW FAST THE CPU COULD RUN. NOW YOU HAVE AN ALTERNATIVE. COMTRADE'S LOCAL BUS SYSTEM USES A 32-BIT VIDEO CARD WHICH NOT ONLY PROVIDES DOUBLE THE DATA PATH, BUT ALSO THE VIDEO BUS RUNS AT TRUE CPU SPEED. THE RESULT IS VIDEO SPEED UP TO 5X FASTER THAN REGULAR SVGA AND UP TO 50X FASTER WITH OUR LOCAL BUS S3 VRAM GRAPHICS ACCELERATOR.



Source: COMPUTER SHOPPER, July 1992, Local Bus Video Review, Page 184.



Circle 497 on Inquiry Card (RESELLERS: 498).

30 Day Money Back Guarantee. Unconditional Two-year Parts Warranty.
One Year On-Site Nationwide Service
Intel Inside Logo is a Trademark of the Intel Corp.

486 EISA Dream Machine

- 256K Super Fast Write-Back Cache SRAM
- 4MB RAM & Expandable to 128MB
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 32-Bit EISA Hard Disk Controller (350% Faster DTR)
- 210MB 12ms IDE Drive with 64K Cache
- Diamond 24X Graphics Accelerator w/ 1MB RAM (Up to 1280x1024 & up to 16.7 million colors) (Up to 30 times faster than standard super VGA)
- 15" Flat Screen 1280x1024 SVGA Color Monitor
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX \$2475

486/50 DX2 \$2625

486/50 DX \$2725

486/66 DX2 \$2975

- 17" Flat Screen 1280x1024 Monitor Add \$460
- 32-Bit EISA Cache IDE Controller (0.1ms) Add \$130

Local Bus SVGA

- 64K Super Fast Write-Back Cache SRAM
- 4MB RAM & Built-in 487 Math Coprocessor
- 1.2MB 5.25" & 1.44MB 3.5" Floppy Drives
- 130MB 15ms IDE Drive with 64K Cache
- 32-Bit Local Bus Turbo SVGA Card w/ 1MB RAM (Up to 1280x1024 & up to 32768 Colors) (7 times faster than standard super VGA)
- 14" Non-Interlaced .28mm SVGA Color Monitor (VESA Standard for 72Hz Flicker-Free Display)
- 2 Serial, 1 Parallel, & 1 Game Ports
- Enhanced 101-Key Keyboard
- Hi-Resolution 400DPI Serial Mouse
- Microsoft DOS 5.0 & Windows 3.1

486/33 DX \$1725

486/50 DX \$2025

- 8MB RAM & 210MB Drive Add \$300
- 32-Bit Local Bus Hard Disk Controller Add \$50

1.800.969.2123



"Where Quality is Everything"

International 818.961.6688

Japan 0473.34.3700

Fax 818.369.1479

Hours: 7:00-7:30 Pacific Mon-Fri
9:00-6:00 Pacific Sat

15314 East Valley Boulevard
City of Industry, California 91746

Multimedia at your Fingertips!

All systems arrive configured with 4MB expandable to 32MB on board, medium tower case (486-33) (mini-desktop case 386-33) with 230 watt power supply; TEAC 1.2 and 1.44MB floppy disk drives; Quantum 120MB, 17ms hard drive w/256K cache; AT/O w/ 2 serial, 1 parallel and 1 game port; NEC internal CD-ROM drive, 280ms access time, 16 bit stereo 32 voice ultra sound card, 16 bit Hi-color VGA adapter w/1MB; 1024 x 768 Super VGA monitor, 28 dot pitch, non-interlaced; 101-enhanced keyboard; Microsoft DOS 5.0; Microsoft Windows 3.1; 3-button serial Microsoft compatible mouse; joy stick, stereo speakers; microphone and headphone

These days, what dollars you spend on multimedia for work or home must be for quality hardware and accessories. Quality! That's exactly what's in your fingertip reach when you purchase our Mega PC.

Megamedia's products are stringently tested for compatibility with the MPC standards. We give you everything you need for a multimedia plug and play system. Our own quality PC; NEC super-fast Multispin CD-ROM for the best in live video animation; an UltraSound audio board that makes your Mega PC sing with 16 bit-44.1Hz sound and a 96db dynamic range for true CD quality audio.

Want more? You'll receive over \$1500 worth of popular CD-ROM titles as well! Plus, your investment is protected by our 30 day no questions asked money back guarantee if you are not 100% satisfied with your Mega PC.

Your telephone and our Mega PC...both are just a fingertip away! Call us today and take advantage of these low prices!



9 More Reasons to Buy a Mega PC!

- ★ All Mega PCs display the MPC trademark, which preserves your investment in multimedia PC software and hardware.
- ★ All Mega PCs are fully tested and have a 48-hour dynamic burn-in to ensure quality performance.
- ★ All software are fully configured and pre-loaded on your hard disk, ready for you to plug and play.
- ★ Live video playback & Photo CD capable with the NEC Multispin CD-ROM, up to 300KB per second transfer rate.
- ★ We provide you with a LIFETIME of free labor for all repairs on equipment returned to us.
- ★ Super audio realism with UltraSound, supports 32-bit & synthesized voices for richer sound effects & music quality.
- ★ Lifetime toll-free tech support.
- ★ Dependability insured with our guaranteed warranty coverage that extends to 18 months on parts.
- ★ Every Mega PC has a 30 day money back guarantee.

**MORE,
MORE &
MORE!**
Over \$1500
worth of
popular CD-
ROM titles.



- ★ **King's Quest V**-an epic battle of strength, wit and magic as you travel with King Graham
- ★ **Compton's Encyclopedia**-26 volumes on one CD-ROM disc, 13000 pictures and diagrams
- ★ **Guinness World Records**-features text of over 7000 world records; includes 300 color pictures.
- ★ **Chessmaster 3000**-definitely a left brain challenge, design and annotate your own games.
- ★ **Mixed-Up Mother Goose**-keep the kids occupied with this colorful, musical animated disc.
- ★ **Power Chords**-hot music composition and editing program. Create your own music quickly and easily.
- ★ **Mavis Teaches Typing**-award winning typing tutor. Enjoy audio voice-over throughout.
- ★ **Autodesk Multimedia Explorer**-Hours of fun creating your own cartoons and animations combine with music for a total MPC show!

...and more!

1-800-Megamedia

1-800-634-2633

1701 D. Fortune Dr. San Jose, CA 95131
Telephone (408) 428-9920 Fax (408) 428-9924

The MPC logo is a trademark of the Multimedia PC Marketing Council Inc. All other trademarks are those of their respective owners. Prices and specifications subject to change without notice. Not responsible for typographical errors.



Visa, MasterCard accepted at no additional charge. If you prepay by a cash instrument we will ship the system free of any freight charges by 2nd day air. Corporate and educational prices welcome with approved credit.

Circle 291 on Inquiry Card.

SPECIAL BONUS

Windows 3.1 Advanced Tutorial Video-Learn to design your independent desktop, manipulate and tailor all aspects of Windows to suit your needs.

MEMORY... YOU JUST CAN'T DO WITHOUT IT.

Picture this:

You bought a new software package. You try it out on your computer and soon find yourself working for hours on a sophisticated graphic design. While scrolling through your worksheet, it feels like you are moving through pudding. Your hard disk has a tough time trying to catch up. You then try to print, but the laser printer's buffer is full. You reset it, try again, and find that it spits out only part of your beautiful graphic....

No problem!

We'll take it from here. With our **JetRam™** line that supports the leading brands of laser printers and **PcRam™** line that upgrades your Notebook, Laptop or Desktop computers, Transcend can help solve your memory problems.

What you get from our memory upgrades

- Life time warranty on all our products
- Full memory lines support a variety of brand names of laser printers and PCs
- High quality at a reasonable price
- Easy-to-install

Office hours: 6:00 a.m. to 6:00 p.m. Mon. to Fri.

"You order in the morning, we will ship in the afternoon."

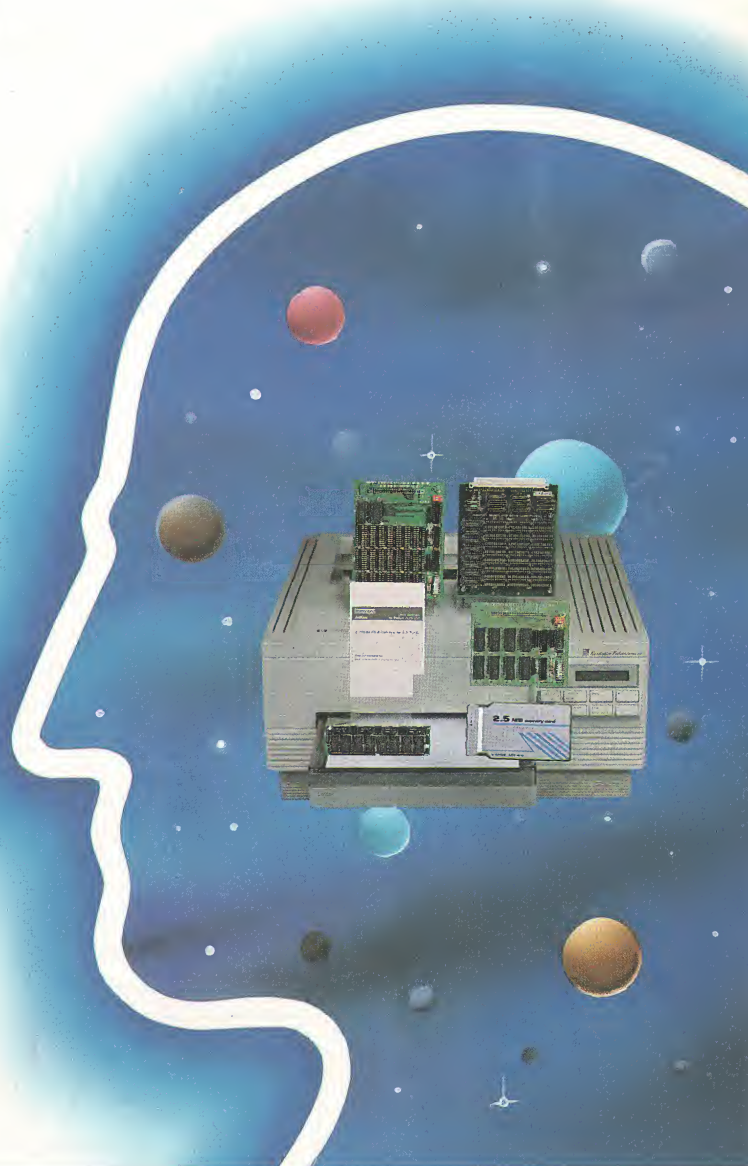
See us at

COMDEX/Fall '92

Booth #S1094



* All brand names are registered trademarks of their respective owners.



Transcend

Your Supplier, Your Partner,
Your Friend.

Transcend Information Inc.

104 Exchange Place,
Pomona, CA 91768 U.S.A.

TEL: (714) 598-5500

FAX: (714) 598-5050, (714) 598-6050

3Fl., No. 465, Chung Hsiao East Road,
Sec. 6, Taipei, Taiwan, R.O.C.

TEL: (886) 2-7881000

FAX: (886) 2-7881919, 7889191

SAVE 50% TO 70%

SATISFACTION GUARANTEED



386SX 40 Meg Laptop/Notebook

800-635-0300

899.

EVEN LESS

Famous Manufacturer

- 386SX 16
- 1 MB RAM Expandable to 2 or 5 MB
- 40 MB High Speed Hard Drive
- 1.44 3-1/2" Floppy Drive
- VGA Screen High Resolution Backlit 640 x 480 Grey Scales

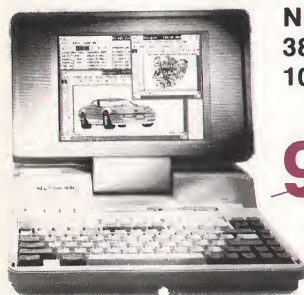
- Removeable NiCad Battery, 2.5 hour
- 110/220 AC Adapter/Charger
- 81 Key Keyboard
- Serial, Parallel & External VGA Port

100 Meg **CALL**

OPTIONS:

- Carry Case
- 1 MB Memory
- 4 Meg

39.
CALL
CALL



NEC
386SX
100 Meg

999.

EVEN LESS

- 16 MHz 386SX
- 1 Meg RAM
- VGA Backlit Screen
- 100 Meg Hard Disk
- 3-1/2" 1.44 Meg Floppy
- Serial & Parallel Ports
- 110/220 Volt Charger
- External VGA Port
- Battery
- 15 lbs.
- 12.9" W x 3.4" H x 14.9" L

OPTIONS:

- Carry Case
- 2400 Baud Modem
- 1 Meg Memory
- 4 Meg Memory
- Expansion Station

59.

99.

99.

CALL

CALL

NEC 386SX Color Laptop

- 16 MHz 80386SX
- 2 MB Memory
- 42 MB Hard Drive
- 3-1/2" 1.44 Floppy
- Display 64 Color Palette
- 640 x 400 EGA/CGA and VGA Mode Support

1599.

EVEN LESS

NEC Panasonic TI
Sanyo Toshiba Bondwell
More!

Famous Manufacturers LAPTOPS/NOTEBOOKS!!

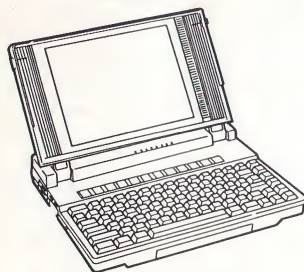
286/386SX/386SL
CGA/EGA/VGA
20/40/60/80 Meg Hard Drives

Options: Case, Extra Memory
Modems...

Starting at

799.

EVEN LESS



Portable Hard Drive

- 6" x 1-3/8" x 8-1/2"
- 2 lbs.
- 20 Meg
- Includes AC Charger & Battery
- Connects to any printer port
- Great for laptops & notebooks

Other sizes
also available...
CALL

279.



CD ROM's

STARTING AT

299.

9 Years

Since 1983

TrueData PRODUCTS, INC.

386 & SX are trademarks of Intel Corporation

775 Quaker Highway, Rte. 146A, P.O. Box 347, Uxbridge, MA 01569

336 B Y T E • NOVEMBER 1992



Famous Manufacturer 386SX/20 60 Meg Notebook

- 20 MHz 386SX
- 2 Meg RAM Expandable to 16 MB
- VGA Backlit Screen
- 60 Meg Hard Disk
- 3-1/2" 1.44 Meg Floppy
- Keyboard, Floppy AT Bus Port
- Serial & Parallel Ports
- 110/220 Volt Charger
- External VGA Port
- Battery
- 6.4 lbs.
- 11" W x 8.5" D x 2.0" H

OPTIONS:

- Carry Case
- Fax Modem
- 2 Meg Memory
- Expansion Station

29.

99.

99.

299.

1099.

EVEN LESS



Famous Manufacturer 386SXL 25 80 Meg Notebook

- 25 MHz 386SXL
- 2 Meg RAM
- VGA Backlit Screen
- 80 Meg Hard Disk Drive
- 3 1/2" 1.44 Meg Floppy
- Ports - Serial, Parallel, VGA, Floppy, Keyboard, AT Bus
- 110/220 Volt Charger
- External VGA Port
- 6.4 lbs.
- 11" W x 8.5" D x 2.0" H

OPTIONS:

- Carry Case
- Fax Modem
- 2 Meg Memory
- Expansion Station

29.

99.

99.

299.

1299.

286 VGA 40 MEG DESKTOP SYSTEM



- 286 12 Mhz
- 1 Meg RAM
- 1.44 Floppy
- 40 Meg Hard Drive
- VGA Card
- VGA Monitor .31 DP
- 1 Parallel, 1 Serial, 1 Mouse Port
- 101 Key Keyboard
- Battery Backed Clock
- Math Co-processor Socket

699.

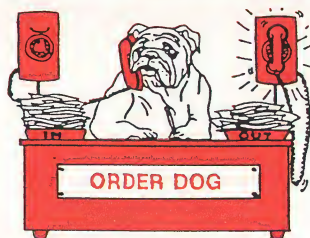
to order:

1-800-635-0300
In MA 508-278-6555

All packages shipped UPS and A.P.O.'s, C.O.D.'s add \$4.00. **ALL RETURNS** must have RMA# (call 508-278-6555). You may be subject to a restocking fee. Shipping/handling charges non-refundable. 1 year warranty unless otherwise noted. Prices/terms/conditions subject to change without notice. Corporate P.O.'s welcomed. International orders also accepted.

MC, VISA, Amex, Discover
All prices are cash discounted prices.

Circle 271 on Inquiry Card.



After 9 years, We're Still Doggedly Determined to Give the Best Doggone Service and Prices to PC Users!

1-800-438-6039

Network

3COM	
3C503 Etherlink II/ 5-pack	189/799
3C503TP 10 Base T	229
3C505B Ethernet Plus	579
3C507 Etherlink 16	279
3C523 MCA Ethernet	299
ARTISOFT	
Starter Kit 2mbps/AE2	325/459
Starter Kit/AE3	539
Lan Cards 2mbps/AE2	129/199
Lan Card AE3	229
Central Station	419
NOVELL	
Novell Lite 1.0/starter kit	69/409
Netware 2.2 5/10 User	519/1099
Netware V.2.2-50 user	1989
Netware 3.11 20/100 User	1899/3648
Netware 3.11-10 User	1375
NE1000/NE2000	129/155
NE 3200	669
Access Server	1595
SMC	
PC130/PC130E	75/99
PC600WS/PC600FS	129/209
HUB 8-Active/4-Passive	249/69
Ethercard 8 bit/16 bit	129/149
Token Card 8 bit/16 bit	349/399
10 Base-T Card 8 bit/16 bit	185/205
3608TP 10BT concentrator	409
3106 16 bit Ethernet 10BT coax	159
3512TP Ether 10BT conc.12 port	709
THOMAS CONRAD	
TC4045 16/4 Token Ring	499
TC6151-11 16 port smart hub	679
TC6242/TC6242-TP+	69/99
TC6245/TC6245-TP+	199/219
TC6045/TC6045-TP+	199/219

Network Software

Borland D Base IV LAN-1 user	249
Borland Quattro Pro V.4.0 ntwkable	319
Close-Up Lan 2user/8 user	249/479
Foxpro Lan 6 user	539
Lotus 2.4 server/node	559/339
Lotus 3.1 server/node	625/409
Norton PC Anywhere V.4.5	119
Norton PC Anywhere V.4.5 Lan	325
Peachtree Network Accounting	489
Procomm Plus Network 5 pack	329
Unreachable Network	429
Word Perfect Office- 5 user	289
Wordstar 2000 LAN-3 pack	259
X Tree Virus Safe Lan	379
X Tree Net/for Unix	319/189

Software

Aldus Pagemaker	499
Carbon Copy/Close Up	110/109
Clarion ProDeveloper	449
Clipper 5.0	489
Corel Draw	365
Dbase IV 1.5	389
Desqview 386	129
Foxbase/FoxPro	195/449
Freelance Plus	309
Harvard Graphics	359
Lotus 2.4/3.1 Plus	345/379
Lotus Symphony	469
Lotus for Windows	415
Smart Suite/Upgrade	449/339
Microsoft Windows 3.1/Word	89/219
Microsoft Word for Windows	299
Microsoft Excel for Windows	319
Norton Desktop for Windows	84
Norton Utilities 6.0	115
Norton AntiVirus	85
Peachtree III Complete DQ	189
Paradox	call
Q&A 4.0	219
Quattro Pro	299
Ventura Desktop Publishing	479
Word Perfect 5.1	255
Word Perfect for Windows	259
Wordstar 7.0/2000+	259/225

Chips

INTEL 387-33	95
INTEL 386-33	89
CYRIX SX16/20/25	77
SX33	95
DX33/40	95/125

Notebooks

TEXAS INSTRUMENTS	
3000-60/80/120	2025/2195/2589
3000 Win SX-60/80	1995/2339
3000 Win SX/120	2699
TM4000 Win- 4MB	
SX/16 w/ 80MB HD	2179
SX/25 w/ 120MB HD	2399
DX/25 w/ 120MB HD	2899
LIBREX	
SX/20 + 4 MB w/40HD	1250
SX/20 + 4 MB w/60HD	1325
SX/20 + 4 MB w/80HD	1450
AST 386SX-20	
43V + w/ 40MB +2MB	1995
63V + w/ 60MB + 2MB	2299
NEC	
Ultralite SX20 w/ 60	2539
Ultralite SX20 w/ 80	2599
Ultralite SX25 color w/ 80	4999
EPSON	
NBSL-20/25	1525/1775
w/ 60/80/120 MB HD	389/542/756

Monitors

NEC MULTISYNC	
3FGX/4FG	689/769
PANASONIC	
1381/1395	329/439
1991-2001 1280x1024	1559
SAMSUNG	
Fiat White ML4571	119
CVB 4995 Syncmaster 2E	269
CVM 4967 Syncmaster 3E	299
CTX	
5468/5468NI	289/329
3436 Multiscan .28	399
1760 17" VGA.28	815
5439/5432	229/275
NANAO	
9070U/9080i	869/1025
5501/5601	1149/1899
VIEW SONIC	
7/6/6SF	1069/369/629

Video Cards

ATI	
VGA Integra 512K	89
Graphics Vantage 1mb	229
Graphics Ultra w/ 1MB	459
8514 Ultra Plus w/ 1MB	389
VGA Wonder XL w/ 1mb	149
BOCA	
Basic VGA/Super VGA	63/129
CARDINAL	
VGA 700/732 w/1MB	119/139
900 w/ 1mb/7000	225/169
ORCHID	
Prodesigner II w/ 1 mb	185
Fahrenheit 1280 degree with 1 MB	289
VIDEO SEVEN	
1024i Plus w/ 512	95
V RAM II 1 mb	269
Win. VGA w/ 1 mb	159

Modems & Fax

CARDINAL	
2400 INT/EXT	62/84
2400 INT/EXT w/MNP	89/99
9600 INT/EXT	249/279
96/24 Fax modem INT	89
HAYES	
Ultra 1.44 V.32	679
Ultra 9600 ext	599
Optima 9600 V.32	349
HEWLETT-PACKARD	
Plain Paper Fax 200/310	999/1339
INTEL	
Satisfaction Modem 200/400	309/409
PRACTICAL PERIPHERALS	
9600 V.42 Int/Ext	269/279
1.44FX fax/modem Int/Ext	350/389
US ROBOTICS	
16.8 HST ext w/ ASL	569
Dual 16.8 HST ext	799
Shared Access Kit	649
ZOOM	
FC 9624	99

Printers

CANON	
LPB4+/LBP8+	919/1499
BJ20	399
BJ 300/330	469/599
DICOMIX	
180si/701	299/439
EPSON	
LX810/AP 3250	155/219
FX850/FX1050	289/379
LQ570/LQ870	269/435
LQ1070/LQ1170	375/579
LQ2550	849
EPL8000/7500	1295/call
DFX5000/8000	1269/2139
HEWLETT-PACKARD	
Laser Series III/IIID	1549/2599
Laser IIP/IIIP	869/1069
Desk Jet 500/500c	399/759
IBM Laser	
6/6P	1479/1825
10/10P	1749/2899
NEC	
Silentwriter 95	1469
OKIDATA	
184/380	229/219
320+/390+	314/439
321+/391+	435/595
393+/393C+	919/999
400/800 LASER	599/925
810/820 LASER	1064/1249
830/840 LASER	1269/1589
3410	1299
PANASONIC	
1123/1124i	199/275
1624/1654	339/539
2180/2123	175/255
1695/2624	369/379
4410/4450i	649/1079
4430/4455	909/1719
QMS	
PS 410/815	1529/2949
Color Script 100 model 10p	4999
LASER ACCESSORIES	
Upgrade for HP III 1 mb	79
Upgrade- HP III 2mb/4mb	109/179
Pacific Data 25-N-1	249
Pacific Page PE/PEXL	269/649
Pacific Connect 256K	249
Complete Font Library	249
Font Bank Cartridge 1.5 Mb	269

Memory Boards

AST	
Six Pack+ w/384K XT	129
Six Pack 286 w/0KAT	95
Rampage PC w/1 mb	285
ORCHID	
Ramquest 16/32 w/KPS/2	199
Ramquest 8/16 w/0KXT/AT	129
ACCELERATOR BOARDS	
OrchidTiny Turbo 286 Xtra	179

Bulldog Systems

Bulldog's Standard Configuration	
Dual Floppy Drives • Super VGA Card	
with 1 Mb RAM • 14" Color VGA	
Monitor (1024 x 768) • DOS 5.0 •	
Windows 3.1 • Mouse • 1 year	
warranty!	
386-SX/25 w/ 2 MB w/ 80 MB HD	1249
386-33 (64K CACHE) 4MB, 130HD	
	\$1549
486-33 (256K CACHE) 4MB, 213MB HD	
	\$2395
486-50 (256K CACHE) 4MB, 213MB HD	
	\$2650
Call for other configurations	

Drives

CONNER	
120 IDE 3.5/200IDE 3.5	329/499
IOmega	
90 MB Insider/Transportable 579/689	
Dual 90 ext	1495
MAGNA VOX	
461RS EXT CDw/ software	369
MAXTOR	
7120A 130 mg	369
7213 A 210 mg	589
MICRO SOLUTIONS	
Backpack Ext. Floppy 1.2/1.44	189
NEC	
CDR 84 int/74 ext	509/549
CDR 37 portable	389
QUANTUM PASSPORT XL removable	
50MB/105MB	359/495
120MB/240MB	699/869
SEAGATE	
ST3086A 89 mb IDE	289
ST 3144A 120 IDE	379
SYSGEN-Mobile Disk	
40/80/120	399/569/649
FLOPPY DRIVES	
360K/1.2MB/1.44MB	59/59/59

Tape Drives

IRWIN	
Accutrak 120/250	189/239
COLORADO MEMORY SYSTEMS	
DJ10 120 Meg Int Jumbo	199
DJ20 250 Meg Int Jumbo	259
Trakker 120	319
Trakker 250	439
QFA 700 Meg Int	719
MICRO SOLUTIONS	
40/120 Backpack	365
80/250 Backpack	429

Mice & Misc.

Microsoft Mouse w/Windows 3.1	149
Microsoft Ball Point Mouse	118
Logitech Fotoman	525
Logitech Scan Man 256	269
Sound Blaster Pro	189

610 Industrial Park Drive
Evans, Georgia 30809
PO Box 211043, Martinez, GA 30907
OPEN weekdays: 8:30 a.m. to 6:00 p.m.
(706) 860-7364 • FAX (706) 860-7358

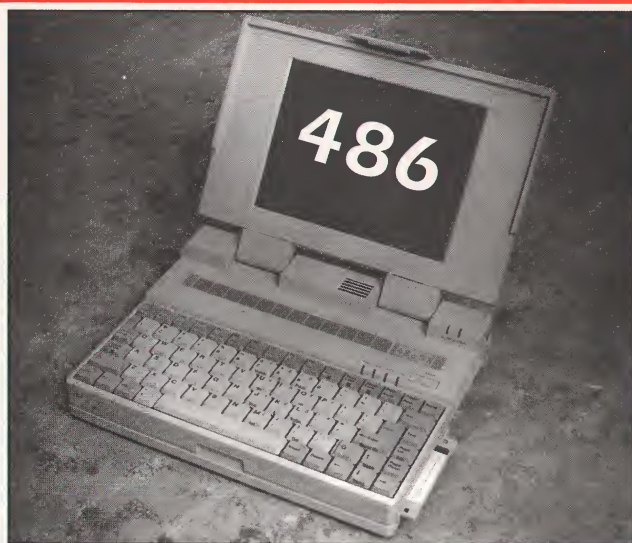


BULLDOG COMPUTER PRODUCTS

No charge for credit cards. Shipping and handling extra (minimum \$6). APO & FPO addresses add \$10. The best way to get the best prices is to call. Product warranties, offers, and discounts are handled by the manufacturer. (DOAs repaired or replaced at our expense during the 90-day warranty period only. No returns on used items. All return shipments are subject to a 15% minimum restocking fee. Defective software is replaced with same item only. Call 800-438-6039 for a Return Authorization number prior to returning any product. Shipping charges are non-refundable. Bulldog cannot guarantee compatibility. All prices are U.S. and are subject to change and availability. Prices are in U.S. dollars and subject to change without notice.

Micro-International Inc.

since 1984, world-wide distribution of quality computer systems and components



486DX2, 66 MHz,

\$3495



486DX, 33 MHz,

\$2695

486DX2, 50 MHz,

\$2995

386DX, 33 MHz,

\$2195

Don't settle for 386SX performance. With 386DX and 486DX power, external keyboard and VGA ports, it is the only computer you will ever need.

HCP Power Notebook Standard Features

- VGA graphics with 32 gray-scale supertwist back-lit LCD screen
- 4 MB RAM installed, total memory capacity is 16 MB
- 120 MB hard disk, 15 ms access time
- 1.44 MB floppy drive
- Three-hour battery
- Carrying case
- Licensed DR-DOS 6.0
- Two serial, one parallel port
- External numeric keypad included
- External VGA and keyboard connections

Optional Features

- | | | | |
|---|-------|--------------------------------|-------|
| ▪ Docking station with 2 x 16 bit slots | \$275 | ▪ Hard drive upgrade to 210 MB | \$400 |
| ▪ Auto cigarette adapter | \$ 45 | ▪ Additional battery set | \$100 |
| ▪ Memory upgrade to 16 MB | \$660 | ▪ Additional battery charger | \$ 35 |
| ▪ Memory upgrade to 8 MB | \$330 | ▪ Additional AC power adapter | \$ 60 |

Micro-International, Inc.



10850 Seaboard Loop
Houston, Texas 77099



Sales 800/967-5667 Tech Support 713/495-9096

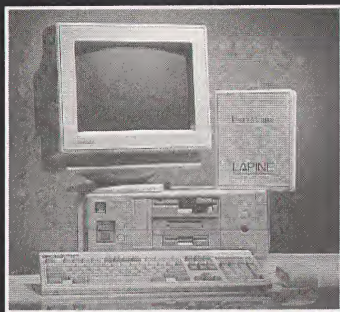
Hours: 9:00 a.m. to 5:00 p.m. M-F; 11:00 a.m. to 1 p.m. Sat. (Central Time)

All systems and components include a one-year warranty; 30-day money-back guarantee.

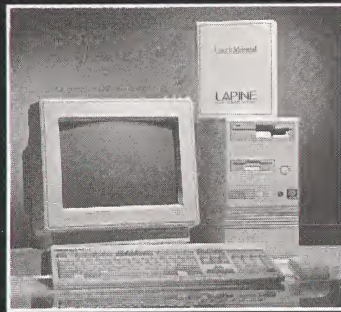
Price reflects cash or credit card payment. Major corporation purchase orders accepted.

The Right Tool For Your Job Is A POWERTOOL

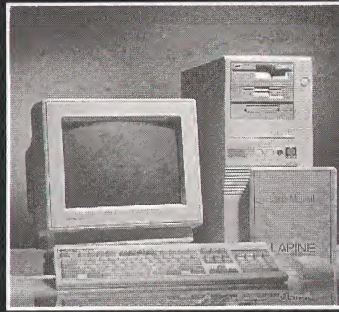
By Lapine.



Standard Desktop



Mini-Upright



Standard Upright

POWERTOOL STANDARDS

- 4MB (60ns/70ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- 16-bit 1MB SVGA card with 32,000 color Sierra® DAC chip
- 280 watt power supply
- TEAC® 1.2 and 1.44MB floppy drives
- LAPINE 101-key tactile keyboard
- 14" non-interlaced .28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- MS-DOS 5.0 and WINDOWS™ 3.1 with hi-resolution mouse
- Your choice of standard desktop, mini-upright or standard upright (see above)

SPECIAL POWERTOOL OPTIONS

POWERTOOL Plus!

8MB base memory, 200MB hard drive and 256K Cache.....add \$292

POWER CACHE!

4.5MB caching hard drive controller for 10X faster processing.....add \$292

- 15" flat screen SVGA monitor upgrade..\$199
- 17" flat screen SVGA monitor upgrade..\$520
- Low radiation monitors
- CD ROM and multi-media
- Tape backups
- And MORE!

LAPINE SERVICE

- 1 year parts and 5 years labor
- Toll free technical support unlimited
- Federal Express replacement parts
- Intensive 72 hour burn-in and test
- 30-day money back guarantee

486-33Mhz
LP-433

\$1692

486-33 Local Bus
486-33Mhz LP-433L

SAME SYSTEM AS ABOVE WITH:

- ★ 32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- ★ Programmable 101-key LAPINE keyboard

\$1892

486-50Mhz
LP-450

\$1942

486-50 Local Bus
486-50Mhz LP-450L

SAME SYSTEM AS ABOVE WITH:

- ★ 32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- ★ Programmable 101-key LAPINE keyboard

\$2242

GRAND POWERTOOLS
486-33 Local Bus
GP-433L

- ★ 16MB (60ns) RAM 256K Cache
- ★ 32-bit local bus S3 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- ★ 17" non-interlaced 1280x1024 SVGA flat screen monitor w/digital control readout
- ★ Programmable 101-key LAPINE keyboard
- ★ SCSI fast drive controller
- ★ 1.2 Gigabyte fast SCSI hard drive

\$4692

486-50 Local Bus
GP-450L

SAME FEATURES AS ABOVE

\$4992

Business Hours:
Monday-Friday 7am-5pm (PST)
8025 Deering Avenue
Canoga Park, California 91304
818/884-3685 FAX 818/884-3670

1-800-927-3772
LAPINE®
Business Compatible Computers

All major credit cards accepted. Net 30 day credit terms to qualified government, educational & commercial accounts. All prices subject to change. Prices do not include shipping.

© 1992 LAPINE Computers

Circle 283 on Inquiry Card (RESELLERS: 284).

NOVEMBER 1992 • BYTE 339

"The CAD Experts RAVE, Now I know Why..."

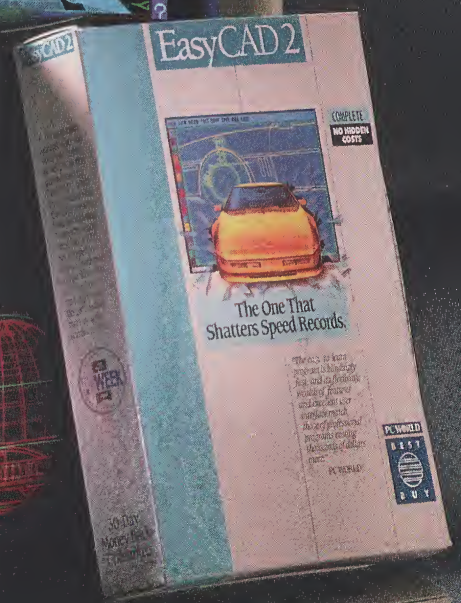
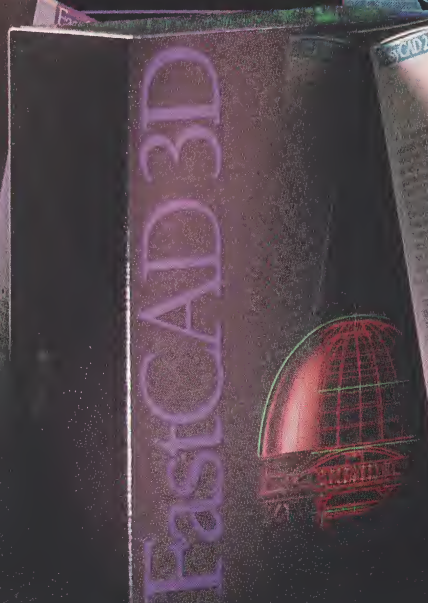
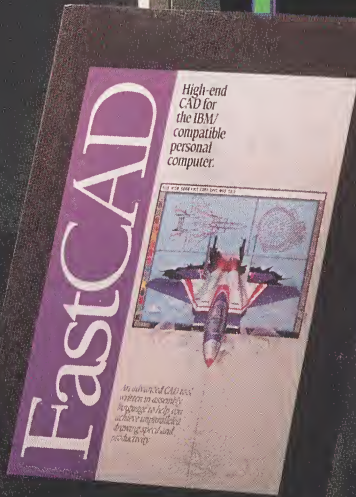
Jim Scalise finds FastCAD®'s speed and ease of use gives more than an increase in quality production time... "We found other systems difficult to learn, but FastCAD enabled us to get up and running in short order. Architects that need the fastest CAD system have to see this to believe it. FastCAD really lives up to its name. Without FastCAD it would be tough to compete and we wouldn't have time for the extensive detailed work we consider standard on all construction documents.

Jim Scalise
Jim Scalise
Nickels + Scalise Architects



Plus, paper storage would be overwhelming and we'd still have 'draftsman's cramp' in our fingers and graphite on our forearms. After winning two National CAD Drawing Contests and elating our clients with FastCAD, it's as easy for me to endorse as it is to use."

If you want to be more competitive, but find yourself short on time, don't delay! Call Evolution Computing today for a free demo at 1-800-874-4028. Free technical support for registered users.



FREE Hands-On Demo, Call 1-800-874-4028 Now!

EasyCAD and FastCAD are registered trademarks of Evolution Computing © 1992 Evolution Computing.

Circle 522 on Inquiry Card (RESELLERS: 523).

Ask for
your copy of
the ACP
Computer
Hotline

ACP-The Superstore with Super Deals!

Hard Drives



Western Digital
High performance
"Caviar" series with 1"
height, Cache Flow™ and 32K buffer.
AC280 80Mb 1" 3.5" 14ms IDE Call
AC2120 125Mb 1" 3.5" 14ms IDE Call
AC2200 200Mb 1" 3.5" 14ms IDE Call

Maxtor
7080A 80Mb 1" 3.5" 15ms IDE Call
7120A 120Mb 1" 3.5" 15ms IDE Call
LX213A 213Mb 1" 3.5" 15ms IDE Call
MX1240 1.2Gb 1" 3.5" 15ms IDE Call
Panthier 1.2Gb 3.5" IDE Call
Panthier 1.7Gb 3.5" IDE Call

Conner Peripherals
30104 120Mb 3.5" 19ms IDE Call
3204 200Mb 3.5" 16ms IDE Call
Call for Quantum, Micropolis, Seagate.
Controllers from Ultrastar, Always, WD etc.

Backups

Colorado
DJ10 120Mb Tape Drive Internal 199
DJ20 250Mb Tape Drive Internal 268
GFA700 700Mb Tape Drive Internal 779
Squest (with cartridge)
44Mb kit \$Q555, \$Q400, \$Q01 (16 bit) 419
44Mb external 499
88Mb kit \$Q5110, \$Q800, \$Q01 (16 bit) 529
88Mb external 629
GrassRoots Floptical
Floptical 21 Mb (external) Call
Floptical 21 Mb (internal) Call

Floppy Disk Drives

Toshiba
ND04DG 360K 5.25" HH PC/XT 59
ND08DEG 1.2Mb 5.25" HH PC/AT 72
ND3561GR 1.44Mb 3.5" HH W/AT Kit 72
ACP
1.2 Mb 5.25" 66 2.88Mb 3.5" Call
1.44Mb 3.5" 67 All in One 3.5/5.25 149
Compaq 1/3 hf. Floppy Call

Multimedia

Sony
7205 CD Laser Library w/six CD's 499
Creative Labs
Complete all-in-one MPC compatible
upgrade kit includes: Panasonic CD Drive,
Sound Blaster Pro, five CD's, Microsoft
Multimedia Kit Int/Ext 539/599
Sound Blaster Reg/Pro 109/199
MediaVision
CDPC Subsystem (external) 1079
Pro 16 Multimedia System 1019
Pro Spectrum Audio Plus 799
NEC Technologies
CDR 7A (ext) w/interface (280ms) 645
CDR 37 (ext) w/interface (450ms) 455
Compton's Encyclopedia CD
Standard version 169
Interactive version, NEW! 249
Procom CD ROM (Int) 299

Input Devices

ACP 3-button Mouse (limited supply) 14.95
CH Products Flightstick 49
Mouseman Combo/Cordless 75/88
Logitech Trackman serial/bus 69/72
Logitech Trackman Portable 104
Logitech Fotoman 599
Microspeed PC-Track ser/bus 79/89

Video Graphics Cards

ATI
Graphics Ultra w/1Mb 399
Graphics Vantage w/1Mb 279
VGA Wonder XL24 w/1Mb 169
VGA Stereo FX 219
Diamond
SpeedSTAR Stealth w/1Mb 265
Speedstar 24-Bit Color 169
Orchid
Fahrenheit 1280 w/1Mb 275
Paradise
Windows Accelerator w/1Mb 245

BELOW COST!
286/12 \$269
80286/12 CPU • 3.5" Floppy • 1 Mb
101 Keyboard • Monitor Extra

Cardinal \$45.95
Modem Bundle
2400 Baud, FREE Prodigy Software
Free software gets you on-line fast!

Chips and SIMM's

RAM Chips
41256-100 256K 100ns DIP 1 25
41256-80 256K 80ns DIP 1.59 1.49
414256-80 256Kx4 80ns DIP 4.79 4.49
1Mb-100 1Mb x1 100ns DIP 4.05 3.95
1Mb-80 1Mb x1 80ns DIP 4.49 4.39
Call for VIDEO RAMS & CACHE RAMS
Over 20,000,000 IC's in-stock including
We Specialize in 486DX/25 & 33 Upgrades

New Low Prices!
SIMM Modules
421000A98-80 1Mbx9 80ns 37.95 32.95
421000A98-70 1Mbx9 70ns 39.95 35.95
424000A98-80 4Mbx9 80ns 125 114
424000A98-70 4Mbx9 70ns 128 117
41256A98-80 256Kx9 80ns 9.95
421000A88-80 1Mbx8 80ns 34.95 31.95
424000A88-80 4Mbx8 80ns 117 105

Math Coprocessors

AMD 80C287...Increase your 286 PC
performance, 80C287-10 \$ 59.95
IBM 8087 Genuine w/manual \$ 29.95
Intel "OverDrive" -Reduced!..... Call
80287's
80287-10 89 80387SX-16 69
80287-20 79 80387SX-20 79
80287XL 88 80387SX-25 79
80387's 80387SX-33 99
80387DX-16 79 80487SX's
80387DX-20/25/33 95 80487SX-20 469
80387DX-40 119 80487SX-25 489
80387SL 99 RapidCad 269

Memory Upgrades

Notebooks
Compaq Lite, 4Mb \$ 239
HP 95LX, 2Mb 479
IBM L40SX, 8Mb 329
Everex Carrier, 2Mb 129
NEC UltraLite SL/20, 6Mb 599
Piquet Palmtop, 2Mb 599
T2000SX, 8Mb 399
T3300SL, 6Mb 319
Laser Printers-"0"K Boards
HP III/IIIid/IIIP/IIIP+/II/IIid 49.95
Pentium 4410/30 or 4420/10 69.95/49.95
Oki 400 49.95 Oki 800/20 59.95
Oki 830/40 79.95 IBM 4019/29 49.95
NEC 69.95 GMS 410 69.95

Computer Upgrades
AST Premium 386/25.33, SX16/20 Call
Compaq DP386/33.486/33 SysPro Call
IBM 30-286 #30F5360 2Mb Call
IBM 35.40.55sx.65.70 #6450604 2Mb Call
IBM 90.95.P75 #6450902 2Mb Call
Call for NEC, HP, Zenith, Leading Edge.

PC MAGAZINE EDITOR'S CHOICE
August 1990 FAX96
fax96 with Modem \$99
WINbest fax 96
Windows for FAX and MODEM! DOS
modem software, FAXography,
COMit for Windows...
2400 MODEM and 9600 FAX (Int.)
WINbest fax96 99
fax96 w/1-liner 179

66 MHz ISA
Micronics
\$1399
Yes, the strongest
engineering board
manufacturer has
just released a 66 MHz
DX2 ISA Motherboard.
Gemini chipset, 256K external
cache, Baby AT, expandable to
32 Mb, Phoenix BIOS and 8 slots!
Micronics
486DX2/66MHz w/256K cache \$ 1399
486DX2/50MHz w/256 cache 999
486DX/50 EISA w/256K cache 1599
486DX/33 w/256K cache 749
486DX/50 ISA w/256K cache 1299

Advanced Computers • with AMD High Performance CPU's • plus SEIKO Trinitron Monitors

...all Advanced Systems include:
• OPI or ACC Chipsets • 1 Year Warranty
• AMI BIOS • Enhanced 101 Keyboard • IDE Interface
• Free Accounting Software
...PLUS Motherboards
manufactured in the
USA!!!

Advanced Computers
486/33 Complete Color System
Includes:
• 486DX/33
• w/256K Cache
• 4 Mb RAM
• 512K VGA Card
• 105 Mb HardDrive
• 1.2 Mb Floppy Disk
• 1.44 Mb Floppy Disk
• IDE Controller
• 101 Keyboard
• 14" SVGA .39
• Color Monitor
ACP's Sale Price \$1499
Call for additional configurations... Local
Bus, 386SX, 486DX/50 and more.
photo may vary
Call for hard drive, Tower, Mini-Tower and other configurations.

Leading Edge 386SL-25MHz Notebook Computers
• Low Power Designs plus SCSI-2
• 2 Mb RAM expand up to 10 Mb
• VGA-64 shades • Mouse
60Mb w/32k Cache.....Call
New! Color 386SL Notebooks 60Mb and 80Mb...Call ACP!
Call ACP for Notebooks... \$1099
386/SX20 Notebook
1 Mb RAM • 3.5" Floppy
30 or 60 Mb Hard Drive
5.8 lbs. • VGA LCD
with 30 Mb
Call ACP for Notebooks... AST COMPAQ MITAC TOSHIBA

Software Sale...up to 90% Off!
35,000 Packages in stock!
Call for a complete list...
Product Title Price
Electric Jigsaw Puzzle 9.95
Bible Trivia 19.95
Dvorak on Typing 12.95
Coinbase 4.0 19.95
Complete Craps 14.95
The Sky 19.95
Computer Comic 14.95
Major League Baseball 24.95
ProFootball Analyst 24.95
Puzzle Master 14.95
Bible Trivia 19.95
Coinbase 4.0 19.95
The Sky 19.95
Flowers 24.95
Trees 24.95
Bugs 29.95
IBM OS/2 Special Purchase
04G1049 OS/2 Extended, w/server, List 1995 ACP 1159
04G1051 OS/2 Lanserver List 795 ACP 429
04G1091 OS/2 Ext. Admin. kit, List 165 ACP 97
10G 5999 OS/2 2.0 Upgrade List 149 ACP 79
While Stock Lasts!

\$77.77
Symantec Norton AntiVirus v2.0
The antidote for your infected systems plus on-going preventative care. Includes Norton's 24-hour Virus FAX-Line for updates when new viruses appear.
Symantec Q&A Database v4.0 \$199
ACP Price only.....
Norton Desktop for DOS 119

After Dark 2.0 for Windows
Prevents screen burn-in. Automatic display of animated screen art of over 40 incredible and novel scenes. Flying toasters, exotic tropical fish...or use your own logo. With SOUND PALETTE™ digital sound effects for bubbling fish tanks, etc...
29.95
New!! Star Trek Call

SII
CM 1450 ...
New low price on an incredibly sharp SVGA flicker-free, non-interlaced multi-scanning monitor. Features finest quality Trinitron high-contrast black tube. 25mm aperture grille and 1024x768 resolution.
CM 1450 14" \$ 469
CM 1760 17" (25mm) 1149
or try SII's new 20" CM 2070 LR 20" 2299

Hayes Optima Modem
New from Hayes, an affordable high performance modem with V.42 speed and throughput up to 9600 baud. Includes SmartCom EZ.
Optima 24 2400 baud (ext) \$ 149
Optima 96 9600 baud (ext) \$ 369
Ultra 144 w/Express 96 (ext) \$ 449

PC6781 SHARP 386SL Note Book
• Weighs Only 4.9 LBS!
• 386SL/20 with 2Mb
• 80Mb Internal Hard Drive
• Built-in Trackball
• IC Card Slot
\$2175

Holiday Gift Idea! Bitstream Lil'Bits Fun Fonts
TrueType fonts with Finestone characters or Star Trek symbols.
Finestone 17.95
Star Trek 17.95
Star Trek Collector's Edition 29.95
Holiday Pack 17.95



Advanced Computer Computer Products, Inc.
1310 E. Edinger, Santa Ana, CA 92705 • FAX 714-558-8849 • Toll-Free 1-800-FONE ACP • Sales 714-558-8813

No surcharge on credit card. Credit cards not charged until we ship. 100% risk free return guarantee! If you are not 100% satisfied just return insured within 15 days complete with all materials in new resalable condition with original invoice. ACP will immediately exchange product or issue ACP credit less shipping for future purchase. No Returns on software Special Purchase



CALL 1-800-FONE-ACP TOLL-FREE ORDERS

1 X 9 \$29
SIMMS 70 NS 12+
4 x 9 \$105

100

9-100NS SIPP	11.75
9-80NS SIPP	14.65
9-70NS SIPP	15.00
9-60NS SIPP	16.00
6 - 1MB	47.00
6 - 2MB	84.00
4MB	138.00
8MB	288.00
16MB	LOWEST
32MB	LOWEST
D-8DNS-4MB SIMM	LOWEST
0-80NS-8MB SIMM	LOWEST

SUPERSPORT SX
2MB MOD ZA1B064 16

2MB MOD	
ZA1806 ALPHA	16
2MB MOD	
ZA18067 BETA	16
Z-286LP PLUS	
2MB KIT Z6051	96
0-16MB E-C N/A	12
Z-386SX, Z-386SX/20	
2MB KIT Z6051	96
0-16MB E-C N/A	12
Z-386-20, /25, /33, /33E	
1MB MOD Z3800ME	50
4MB MOD Z3800MK	199
Z-486/33ET	
4MB KIT ZA4200M2	203
16MB KIT ZA4200M8	754

NOTEBOOK

ALTIMA LAPTOP SX	
1MB MOD	\$ 80
2MB MOD	150
4MB MOD	250
BONDWELL 8310 SUPERSLIM	
BONDWELL 8310V-8310SX	
1MB MOD	150
CHICORY 386SX	
4MB MOD	195
CHAPLET NOTEBOOK	
1MB MOD	110
2MB MOD	150
4MB MOD	240
GOLDSTAR GSS20 386SX/16	
1MB MOD	138
4MB MOD	335
HEWLETT PACKARD LS/12	
1MB MOD	118
HEWLETT PACKARD 95LX	
128K MOD	115
256K MOD	145

512K MOD	165
1MB MOD FLASH	290
4MB MOD FLASH	995

HYUNDAI 386SX	
4MB MOD	195
LIBREX 286	
2MB MOD	225
LEADING EDGE DLT/386SX	
1MB MOD	95
MAGNAVOX METALIS 286, 386SX	
1MB MOD	99
4MB MOD	299
mitsuba nimja 286, 386SX	
1MB MOD	99
4MB MOD	299
PACKARD BELL PB286NB	
1MB MOD	99
4MB MOD	299
PACKARD BELL PB386NBX	
1MB MOD	99
2MB MOD	155
4MB MOD	299
PODIET	

128K MOD	115
256K MOD	145
512K MOD	165

1MB MOD FLASH	290
4MB MOD FLASH	995
SAMSUNG NOTE MASTER 386S	
2MB MOD	179
4MB MOD	379
SANYO 17NB, 16NB, 15NB6	
2MB MOD	145
SAMP NB SX16	
1MB MOD	85
2MB MOD	145
4MB MOD	245
SAMP NB SX25	
2MB MOD	145
4MB MOD	245
AMON NB386SX	
1MB MOD	95
4MB MOD	280
6MB MOD	480
TULIP LAPTOP	
4MB MOD	245
FDS NOTEBOOK	

2MB MOD 145
LASER

LASER PRINTER MEMORY	
HP J6170 RX 7100, 7200M	\$ 295
2MB	
SONICA LP3110, 3115	
1MB	146
2MB	210
3MB	290
YOCERA F1200S, F3300, 3300A	
1-2-3-4MB	CALL
YOCERA F820, F1800, 1800A, F3000A, F5000	
1MB	98
T10H-4 PLUS +8E	

1MB	120
-----	-----

CACHE MEMORY	
8-15	10.00
8-15	25.00
8-25	7.00
8-25	16.80
4-25	21.00
4-25	7.00
8-20	8.00
8-20	17.50
4-20	22.50
4-20	8.00

0116

**OPEN 6 DAYS.
ORIGINAL INVOICE
S AFTER 14 DAYS,
CT TO APPROVAL.
ARRANTY EXCEPT**



N45SL-120 meg, notebook	2950
N51SX-80 meg, notebook.....	2650
PS/2 57-160 meg	2370
PS/2 40SX-40 meg	1590

*** Monitor Extra ***



MEGACUBE EISA BUS

486-33 MHz System
8 meg, 128K Cache, SCSI

3695

486/33 MHz System

4 meg, 256K Cache, 1.2 &
200 meg drives, SVGA Combo.....

2995

Carrier 386sx/25 Mhz Notebook

4 meg, 120 meg Hard Drive, VGA

2195



Power Premium 4/50.....

2290

Power Premium 4/33.....

1995

Power Premium 4/25s.....

1725

HARD DISK & MONITOR EXTRA

CD ROM/Multi Media

NEC CD ROM 37M-Gallery

570

NEC CD ROM 74M-Gallery

680

Sound Blaster Pro

205

BRAND NAMES

LOW PRICES

LEADER
SINCE 1983

We export to Europe, Asia
& the Far East

We Honor Manufacturer's
Warranties

Call for details

NOTEBOOKS

TI TravelMate 4000, 386SX, 120 meg

CALL

Compaq LTE Lite 386SL

CALL

Toshiba 2200SX, 80 meg

CALL

Toshiba 4400SXC, 120 meg.....

CALL

Toshiba 6400SXC, 120 meg.....

CALL

Toshiba 3300SL, 80 meg

CALL

AST

Power Exec 386SX/25, 80 meg

1625

Power Exec 386SX/25C, 80 meg

2735

Power Exec 386/25SL, 123 meg W

2475

Power Exec 386/25SLC, 83 meg

3175

Call for pricing on other brand name models



ProLinea 3/25zs, 84 MB.....

909

ProLinea 4/25s, 240 MB

1595

Prolinea 4/50, 240 MB

2275

DESKPRO 3/25i, 120 MB

1695

DESKPRO 4/25is, 120 MB

1810

DESKPRO 4/66i, 210 MB

2675

DESKPRO 386/33M, 120 MB

2335

DESKPRO 486/33M, 340 MB

3520

DESKPRO 50M, 340 MB

3995

DESKPRO 66M, 510 MB

4730

Portable 486, 210 MB

6278

Portable 486c (color), 210 MB

8826

Contura 386SL/25, 120 MB

2299

LTE Lite/25, 120 MB

2875

LTE Lite/25c, (color), 120 MB

4910

SYSTEMPRO/LT

486/33, 1020 MB.....

7552

486DX2/50, 1020 MB

9350

* Call for other models - Monitor Extra *



Netware 386 V.3.11

Authorized Dealer

5 users.....

695

10 users.....

1395

20 users.....

1895

100 users.....

3795

250 users

CALL

WE STOCK
TOSHIBA

CITIZEN
OKIDATA
EPSON

HITACHI
TALLGRASS
ARCHIVE

NEC
ALR
WYSE

HOUSTON INSTRUMENTS
MICROSOFT
SUMMAGRAPHIC

INTEL
PC MOUSE
CALCOMP

AES Computers

All systems include

- Intel CPU with 4 meg RAM
- Desktop or tower case
- 2 serial, 1 parallel, 1 game (joystick) ports
- 101 AT enhanced keyboard
- 1.2 (5.25") & 1.44 (3.5") TEAC floppy drives
- SVGA card w/1 meg & SVGA 0.28mm monitor
- MS DOS 5.0 (complete w/manuals)
- MS Windows 3.1 (complete w/manuals) & mouse

486/50 with 200 meg HD.....

2150

486/33 with 120 meg HD.....

1860

386/40 with 120 meg HD.....

1390

386SX/25 with 40 meg HD.....

950

One year limited warranty

Made
in
USA

LAN BOARDS

8 bit Arcnet

75

16 bit Arcnet

160

Novell NE 1000

160

Novell NE 2000

175

8 port Active Hub

325

Token Ring Card

399

Tokenhub 4-port

355

Call for other
LAN Accessories

SVGA Monitors

NEC 3FGX, 14"

665

NEC 4FG, 16"

825

NEC 4DS, 16"

875

Viewsonic 4E, 14"

365

Viewsonic 8, 17"

1785

Aamazing, 14"

335

PRINTERS

Epson LQ 570

289

Epson LQ 1170

565

OKIDATA ML320.....

315

OKIDATA ML390.....

460

HP DeskJet 500

399

HP PaintJet

705

Citizen, Panasonic ..

CALL

HARD DISKS

CONNOR

CP30104 120 meg....

CALL

CP3204F 220 meg....

CALL

QUANTUM

Pro Drive 120 meg ...

CALL

Pro Drive 240 meg ...

CALL

MAXTOR, SEAGATE

MICROPOLIS, MICRONET

CALL FOR ALL MODELS

LASER PRINTERS

HP Laser IIISI

3595

HP Laser IIID

CALL

HP Laser III

1495

HP Laser IIIP

CALL

HP IIP Plus

CALL

OKI OL 400, 800

CALL

OKI OL 840 P.S.

1720

Panasonic 4450

1295

NEC Model 95

1465

Corporate Accounts
Welcome

Call for Discounts
on Volume

And
Consultant Orders

Exports
Available

Computerlane inc.

Outside California: 1-800-526-3482

Inside California: 818-884-8644 • FAX: 818-884-8253

7500 Topanga Canyon Boulevard, Canoga Park, CA 91303

Hours: Monday - Friday 9 -6, Saturday 10-6

Compaq is a Registered Trademark of Compaq. IBM is a Registered Trademark of International Business Machines.

ALL QUOTED
PRICES ARE CASH
PRICES ONLY

Visa, MasterCard
and
American Express
are higher

Prices subject to change
without notice.

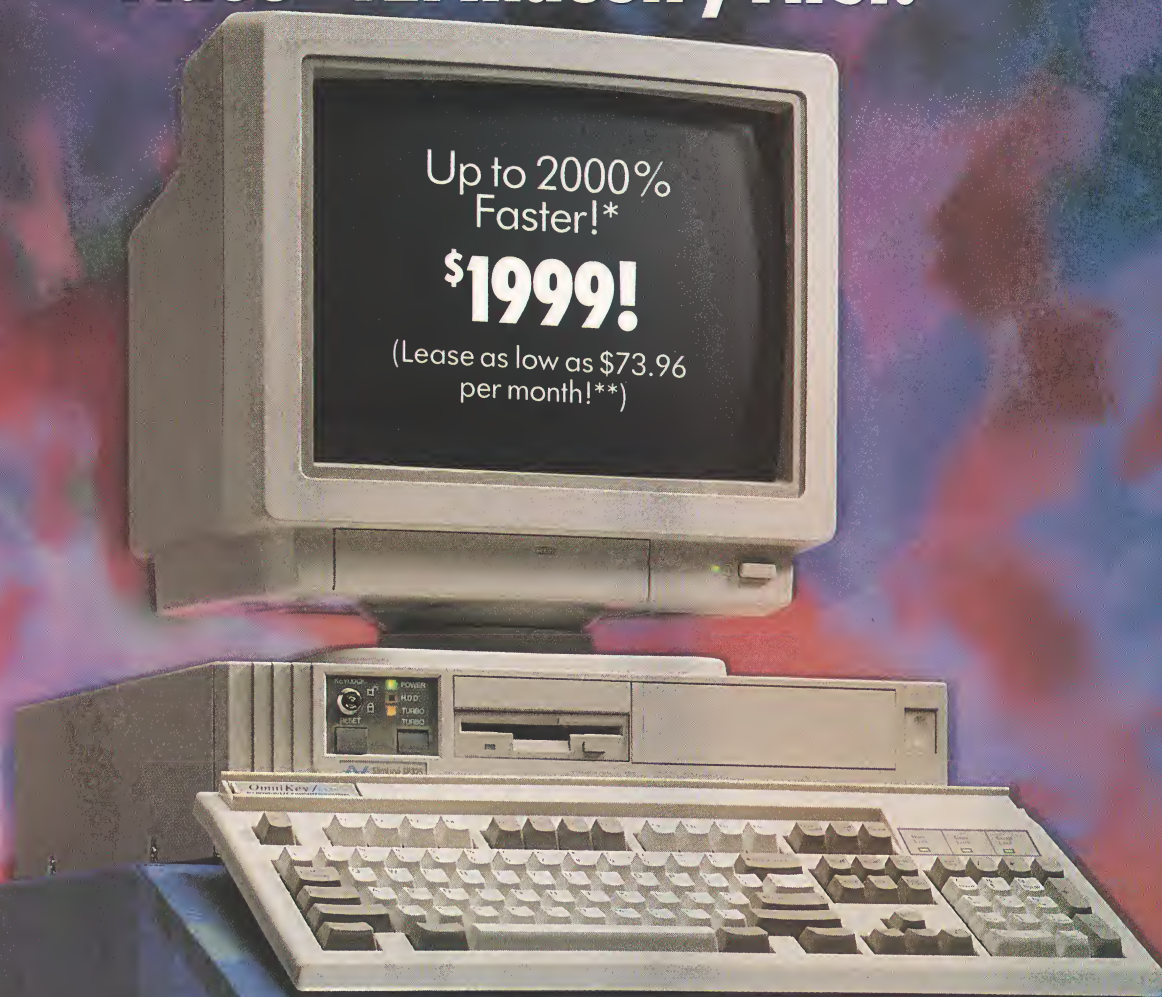
*Quantities are limited

NEW!

Northgate® SlimLine™ Is Back And Faster Than Ever!

DX2/66
Available
Now!

Northgate Local Bus High Speed Windows And GUI Video – An Industry First!



Northgate ZXP System With Unlimited Upgradability - Compatible With Intel® SX/25, DX33, DX2/50, DX2/66 And All OverDrives!

A Northgate Exclusive! No other computer offers this price/performance!

- Intel 80486SX™/25 MHz processor
- 4MB of RAM; expands to 32MB on board
- Virtual Cache – Zero Wait State Performance
- 100MB hard drive
- 1.2MB or 1.44MB floppy drive
- High-speed local bus VGA with 1MB video RAM
- 1024 x 768 monitor
- MS-DOS® 5.0, Microsoft® Windows™ 3.1 and mouse
- Award-winning Northgate service and support
- 30-day no-risk money back guarantee
- Winmarks (V2.5) of 7.9 million;
- PowerMeter™ MIPS (V1.7) of 14.8



Call for more information!
800-345-8709



Major corporations, volume purchasers and government agencies call National Business Accounts: 800-545-6059

GSA# GS00K91AGS5193 PS01

Major credit cards, money orders, direct wire and approved company purchase orders accepted.

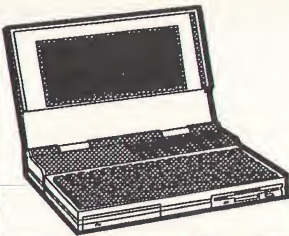


7075 Flying Cloud Drive, Eden Prairie, MN 55344

"When it has to work right"™

©Copyright Northgate Computer Systems, Inc. 1992 All rights reserved. Northgate, SlimLine, ZXP and the Northgate 'N' logo are U.S. trademarks or registered U.S. trademarks of Northgate Computer Systems. 80486SX and 80486 are U.S. trademarks of Intel. MS-DOS, Windows and Microsoft are U.S. trademarks or registered U.S. trademarks of Microsoft Corporation. All other products and brand names are U.S. trademarks and registered U.S. trademarks of their respective companies. Prices and specifications subject to change without notice. Prices shown do not include shipping/handling charges and applicable sales taxes. Northgate reserves the right to substitute components of equal or greater quality or performance. All items subject to availability. We support the ethical use of software. To report software copyright violations, call the Software Publishers Association's Anti-Piracy Hotline at 1-800-388-PIR3. All systems shipped with DiagSoft™ QA Plus™ software. **Monthly lease payments are based on a 36-month standard fair-market value open-ended lease. 12-60 month leasing options available for qualified businesses.

CODE B46



The difference between their prices and ours is simply too great to ignore. No wonder we've been around
SINCE 1984

(AND WHAT AUDACITY THE COMPETITION HAS TO CLAIM THAT THEY WON'T BE UNDERSOLD)

"DETERMINED TO BE BEST / DESTINED TO BE FIRST"

TOSHIBA MEMORY

T2200SX, T2000SX, T2000SX, T2000,
 T5100, T3200SX, T3100SX, T3100e,
 T1600, T1200XE, T1000XE/SE/LE,
 and T1800, T1850, and T1850C

2MB..\$ 77
 4MB..\$156
 6MB..\$218
 8MB..\$293
 *ALL CARDS
 ARE FAST 70ns

PCMCIA SRAM MEMORY

DEC PALMTOP, DELL 320SLI SUB-NOTEBOOK, GRID GRIDPAD,
 HP 95LX, IBM PC RADIO, MOMENTA PENTOP, NCR 3125 NOTEPAD
 POQET, SHARP PC3000/3100, SHARP PC-6700/6741/6781/6785,
 SHARP PC-6800/6841/6881, TOSHIBA T3300SL, ZEOS POCKET PC
 512K \$127 1MB \$189 2MB \$350

COMPAQ LAPTOP MEMORY

CONTURA 2MB/4MB/8MB \$108/\$202/\$368
 LTE386s/20 1MB/4MB \$ 88/\$198
 LITE/20 & LITE/25 1MB/4MB/8MB \$ 88/\$198/\$336

SHARP PC-6781

80MB HDD W/ 8MB \$2132
 120MB HDD W/ 8MB \$CALL

MATH COPROCESSORS

80287-10/12 \$63
 80387SX-16/20/25 \$80
 80387DX-20/25/33 \$88
 80387DX-40 \$116
 80487SX \$598

SHARP PC-6700, 6741, 6781, 6785,
 6800, 6881 RAM UPGRADES
 2MB \$129 4MB \$237

UPGRADED NOTEBOOKS

AST PowerEXEC 3/25SL 160MB W/ 8MB RAM	\$2970
SHARP PC-6340/40MB W/ 2MB RAM	\$1198
SHARP PC-6881/80MB COLOR W/ 8MB RAM	\$4186
SHARP PC-6881/120MB COLOR W/ 8MB RAM	\$CALL
TEXAS INSTRUMENTS TM3000/120MB W/ 6MB RAM	\$2278
TOSHIBA T3300SL/120MB W/ 18MB RAM	\$3508
TOSHIBA T4400SX/120MB LCD W/ 18MB RAM	\$3964
TOSHIBA T4400DX/120MB LCD W/ 18MB RAM	\$4298
TOSHIBA T4400SX/120MB PLASMA W/ 18MB RAM	\$4135
TOSHIBA T4400DX/120MB PLASMA W/ 18MB RAM	\$4469
TOSHIBA T4400SX/120MB COLOR W/ 20MB RAM	\$5879
TOSHIBA T4400DX/120MB COLOR W/ 20MB RAM	\$6212
TOSHIBA T6400SX/120MB W/ 20MB RAM	\$4054
TOSHIBA T6400SX/120MB COLOR W/ 20MB RAM	\$7507
TOSHIBA T6400DX/200MB W/ 20MB RAM	\$8002
TOSHIBA T6400DX/200MB COLOR W/ 20MB RAM	\$8555
TOSHIBA T4400SX/T6400SX DX UPGRADE KIT	\$ 499

LAPTOP/NOTEBOOK MEMORY

AST PREMIUM EXEC 4MB (70ns LP)	\$116
COMMODORE CLT286/386 2MB (70ns LP)	\$77
COMPAQ SLT286 4MB	\$328
COMPAQ SLT386S 4MB	\$218
COMPUADD COMPANION/SX 2MB (70ns)	\$58
EVEREX TEMPO/LX 2MB/4MB (70ns LP)	\$77
GRID 1720/1750 2MB	\$88
IBM N335X 2MB/4MB (70ns LP)	\$98/\$158
IBM CL57SX 2MB/4MB/8MB	\$176/\$247/\$488
IBM N51SX/N51SLC 2MB/4MB/8MB	\$221/\$398/\$573
NEC ULTRALITE 286F 4MB	\$208
PANASONIC CF170/270/370 1MB/2MB	\$58/\$88
SANYO MBC -17NB/18NB 2MB (70ns LP)	\$77
SHARP PC-6600/6641/6681 2MB (70ns)	\$58
SHARP PC-6501 COLORSTAR 2MB	\$119
TANDY 1500HD/2810HD/3810HD 1MB/2MB	\$58/\$88
TI TRAVELMATE TM3000 2MB (70ns)	\$58
TOSHIBA T3300SL 2MB/4MB/8MB/16MB	\$102/\$156/\$263/\$767
ZEOS 286/386SX NOTEBOOK 2MB (70ns)	\$77
ZENITH MASTERSPORT SX/SL/SLC 2MB (70ns)	\$77

CALL FOR PRICES ON MODEMS & FAX/MODEMS FOR YOUR COMPUTER

DESKTOP MEMORY

AST BRAVO 3/33e 2MB	\$ 74	COMPAQ PROLINEA 4/33 8MB	\$338
AST BRAVO 3/33e 8MB	\$288	COMPAQ PROLINEA 4/33 4MB	\$143
AST BRAVO/486 4MB	\$156	COMPAQ PROLINEA 3/25 8MB	\$285
AST BRAVO/486 16MB	\$533	COMPAQ DESKPRO 386e 4MB	\$169
IBM 6450128 4MB	\$158	EPSON EISA SERIES 16MB	\$533
IBM 6450129 8MB	\$298	EPSON EQUITY486PLUS 4MB	\$157
IBM 6450130 8MB	\$298	ZENITH Z-STATION 16MB	\$533
IBM 6450603 1MB	\$ 60	ZENITH Z-STATION 4MB	\$156
IBM 6450604 2MB	\$ 83		

LASER PRINTER MEMORY

APPLE LASERWRITER I/II/IIXTX 4MB	\$137
AT&T 593 LASER / C. / TOH-6 2MB/4MB	\$118/\$188
BROTHER HL-44/4V/4PS 2MB/3MB/4MB	\$126/\$161/\$196
BROTHER HL-8E/8D/8V 2MB	\$133
CANON LBP 8I/II/III/III 2MB/4MB	\$105/\$175
DATAPRODUCTS LZR650 1MB/1.5MB/2.5MB/4MB	\$105/\$135/\$188/\$345
EPSON ACTION LASER PLUS / EPL6000 2MB/4MB	\$118/\$188
EPSON ACTION LASER II / 4100/8000 2MB/3MB/5MB	\$111/\$165/\$255
EPSON EPL-7000 2MB/3MB	\$126/\$161
FACIT P6060 2MB/4MB	\$118/\$188
HP LASERJET II/II 2MB/4MB	\$105/\$175
HP LASERJET II/II/II/II/II/II 2/3/4MB	\$98/\$133/\$168
HP LASERJET FAX 1MB	\$91
HP LASERJET IIIS/PAINTJET XL300 1MB/4MB	\$53/\$133
HP DESIGN JET PLOTTER 1MB/4MB	\$53/\$133
HP DESKJET+/500/500C 256K	\$56
IBM/LEXMARK 4019/4019e 2MB/3.5MB	\$111/\$153
IBM LEXMARK 4029 (ALL MODELS) 2MB/4MB	\$105/\$146
KYOCERA F800/800A/800T 2MB/4MB	\$140/\$210
KYOCERA F1200S/3300 2MB/3MB/4MB	\$157/\$192/\$227
MANNESMANN TALLY 905 2MB/4MB	\$118/\$188
NCR 6435 2MB/4MB	\$118/\$198
NEC SILENTWRITER 2 MODEL 90/290 /S60/S60P 2MB	\$136
NEC SILENTWRITER 2 MODEL 95 /S62P 2MB	\$119
OKIDATA OKILASER/400 2MB	\$101
OKIDATA OKILASER 800/820 2MB/3MB/4MB	\$119/\$154/\$189
OKIDATA OKILASER 810 2MB/3MB/4MB	\$144/\$179/\$214
OKIDATA OKILASER 830/840 2MB	\$154
OLIVETTI PG-108/208 2MB/4MB	\$105/\$175
PACKARD BELL PB-9600 2MB/4MB	\$118/\$188
PANASONIC IXX-P4410/4430 2MB/3MB/4MB	\$133/\$168/\$203
PANASONIC IXX-P4420/4451/4450 2MB/3MB/4MB	\$111/\$146/\$181
PANASONIC IXX-P4450 1MB	\$109 NEW!
PANASONIC IXX-P4455 2MB	\$133
QMS PS410 2MB/3MB/4MB	\$126/\$161/\$196
QMS PS815/825 2MB/4MB/8MB	\$168/\$238/\$308
QMS PS1700 1MB/4MB	\$53/\$133
SHARP JX-9500/9700 1MB/1.5MB/2.5MB/4MB	\$105/\$135/\$188/\$345
SHARP JX-9500PS POSTSCRIPT 1MB	\$58
STAR LASER PRINTER 8 2MB/4MB	\$143/\$213
STAR/STARSCRIPT 4/III 2MB/4MB	\$158/\$251
TEC 1305B 2MB/4MB	\$118/\$188
TI MICROLASER (ALL MODELS) 1MB	\$58
TOSHIBA PAGELASER6 2MB/4MB	\$118/\$188
UNISYS AP9210 2MB	\$111

NOTE: ALL MEMORY UPGRADES COME WITH THE MEMORY BOARD AND THE MEMORY CHIPS ALREADY INSTALLED.

AMIGA A600/A600HD 2MB/4MB/8MB UPGRADE	\$CALL
APPLE TOWER RING 4/16 NuBUS CARD 2MB UPGRADE	\$144
APPLE LASERWRITER NTR 2MB MEMORY REPLACEMENT	\$ 94

WE ARE LISTED IN THE TOSHIBA
 TECHNICAL INFORMATION GUIDE
 AS "THE LEAST EXPENSIVE
 MEMORY MANUFACTURER
 APPROVED FOR TOSHIBA
 LAPTOPS AND NOTEBOOKS" !!!

TOSHIBA T5200/T8500
 2MB/8MB \$88/\$297

TOSHIBA T4400SX/T6400
 2/4/8/16MB \$128/\$168/\$325/\$767

\$68

1MB RAM UPGRADE
 SHARP PC-6220
 TI TRAVELMATE TM2000
 COMPUADD COMPANION

HDD UPGRADES
 40MB/60MB/80MB/120MB
 \$182/\$228/\$338/\$CALL

EVERYONE ELSE CLAIMS THEY
 WILL BEAT ANY PRICE. WE DON'T
 EVEN CLAIM IT. INSTEAD, WE JUST
 DO IT. YOU BE THE JUDGE!

TOSHIBA T5200
 200MB HDD UPGRADE
 \$698

IBM L40SX RAM UPGRADES
 2MB 4MB 8MB
 \$91 \$140 \$270

ALL MEMORY UPGRADES
 COME WITH A LIFETIME
 WARRANTY & A 48 HOUR
 EXCHANGE GUARANTEE!

APPLE POWERBOOK
 2MB.....\$112
 4MB.....\$195
 6MB.....\$267
 *4MB & 6MB FOR MODEL
 100 SLIGHTLY HIGHER

SE HABLA ESPANOL
 pregunte por Hector

tote-a-lap

550 Pilgrim Drive, Ste.F, Foster City, CA 94404
 PHONE: (415)578-1901 FAX: (415)578-1914
 ORDERS ONLY: 1-800-9-LAPTOP
 (PRIOR APPOINTMENTS ARE NEEDED FOR WILL-CALLS, PLEASE)

TERMS AND CONDITIONS: All sales final. We charge a 25% re-stocking fee on all re-fused shipments and pre-approved returns. Prices are subject to change w/out notice, and reflect all cash discounts. Warranty on all merchandise, except memory upgrades, is thru the original manufacturer only, unless previously agreed upon and stated on our invoice. All software, plus all merchandise that include a rom bios, are not returnable for credit, and are subject to an even exchange only. We accept purchase orders from credit-worthy institutions, although prices may be slightly higher on some items. We will not ship to any account with an overdue balance. Purchase prices at the time of sale are final.

AMT INTERNATIONAL

(COMPUTERS & PERIPHERALS)

3074 LANDESS AVENUE · SAN JOSE, CA 95132
TEL: (408) 942-9695 · FAX: (408) 942-5509



LOWEST PRICES
SAME DAY SHIPPING

COMPAQ MEMORY

DeskPro 286-E, 386-20/20E/25	
1MB 113131-001	\$75.00
4MB 113132-001	\$169.00
DeskPro 286N, 386N and 386SX	
2MB 118689-001	\$135.00
4MB 118690-001	\$230.00
DeskPro 386S	
1MB 113646-001	\$99.00
4MB 112534-001	\$195.00
DeskPro 386-33, 486-33 & SystemPro	
2MB 115144-001	\$185.00

AST MEMORY

Bravo-286, Workstation	
512K Kit 500510-010	\$59.00
2MB Kit 500510-002	\$150.00
Premium 386-16/20C	
1MB Kit 500510-003	\$75.00
4MB Kit 500510-004	\$185.00
Premium 386-20	
1MB Kit 500510-003	\$75.00
4MB Kit 500510-004	\$185.00
Bravo-386SX	
4MB Kit 500510-008	\$220.00
Premium 386-SX/25/33 & 486-25	
1MB 500718-002	\$60.00
4MB 500-780	\$195.00

HEWLETT-PACKARD MEMORY

Vectra QS/16S	
1MB	\$65.00
4MB	\$185.00
Vectra QS/28PC, RS/25PC and 20C	
1MB D1640A	\$65.00
4MB D1642A	\$170.00
Vectra 486PC	
1MB D2150A	\$75.00
4MB D2151A	\$165.00

IBM PS/2 MEMORY

Models 30-286, Exp. Board 1497259	
512K Kit 30F5348	\$54.00
2MB Kit 30F5360	\$95.00

Models 70-E61/121, 55SX, 65SX	
1MB 6450603	\$59.00
Models 70-E61/121, 50Z, 55SX, 65SX	
2MB 6450604	\$99.00
Models 55SX, 65SX, 34F3077 & 34F3011	
4MB 34F2933	\$149.00
Models 70-A21	
2MB 6450608	\$99.00
Models 80-141	
1MB 6450375	\$75.00
Models 80-111/311	
2MB 6450379	\$99.00
All Models 70 and 80	
2-14MB w/2M 34F3077	\$290.00
4-16MB w/4M 34F3011	\$350.00
Models 50, 50Z, 55SX & 80	
2-8MB 1497259	\$290.00

LASER PRINTER MEMORY

Hewlett-Packard Laser Jet IIP, III & IID	
1MB 334748	\$70.00
2MB 334758	\$99.00
4MB 334778	\$185.00
Hewlett-Packard Laser Jet IIP & IID	
1MB 334438	\$75.00
2MB 334448	\$110.00
4MB 334458	\$175.00
IBM Laser 4010 and 4019e	
1MB 1038137	\$95.00
3.5MB 1038675	\$195.00
Canson LBP-811, 811R, 811T	
2MB S63-1880	\$129.00

LAPTOP AND PORTABLE MEMORY

TOSHIBA MEMORY	
1MB Model 1000SE/XE	\$110.00
2MB Model 1000SE/XE	\$99.00
2MB Model T1200XE	\$99.00
2MB Model T1600	\$99.00
2MB Model T3100E	\$99.00
2MB Model T3100SX	\$99.00
4MB Model T3100SX	\$195.00
2MB Model T3200SX	\$99.00
4MB Model T3200SX	\$195.00
2MB Model 5100	\$99.00
2MB Model T5200, T8500, 1100	\$110.00
8MB Model T5200, T8500	\$299.00

ZENITH MEMORY	
1MB SuperSport 286 & 286ES	\$135.00
2MB SuperSport 286 & 286ES	\$140.00
2MB SuperSport SX/Alpha	\$140.00
2MB SuperSport SX/Beta	\$140.00
COMPAG MEMORY	
1MB Portable LTE 286	\$125.00
2MB Portable LTE 286	\$150.00
1MB SLT-286	\$140.00
4MB SLT-286	\$350.00
NEC MEMORY	
1MB Prospeed 286	\$170.00
2MB Prospeed 386	\$240.00

ZENITH MEMORY

Zenith Z-386/20/25/33 & 33E	
1MB ZA36/3800ME	\$90.00
2MB ZA3600MG	\$140.00
4MB ZA3800MK	\$205.00
Zenith Z-386 SX	
2MB Z-605-1	\$125.00

MATH COPROCESSORS

INTEL	
8087-5 MHz	\$50.00
8087-2 8MHz	\$60.00
8087-1 10MHz	\$105.00
80287-6 6MHz	\$50.00
80287-8 8MHz	\$59.00
80287XL 8/10MHz	\$89.00
80287XL & XLT	\$89.00
80287-10 10MHz	\$59.00
80C287-12 12MHz	\$89.00
80387SX-16	\$85.00
80387SX-20	\$85.00
80387DX-25	\$89.00
80387DX-33	\$89.00
80487SX-20	\$435.00
WEITEK	
3167-20 20MHz	\$80.00
3167-25 25MHz	\$135.00
3167-33 33MHz	\$240.00
4167-25MHz	\$325.00
4167-33MHz	\$595.00
CYRIX	
82S87XL	\$59.00
83D87-16	\$59.00

83D87-20	\$85.00
83D87-25	\$85.00
83D87-33	\$85.00
83D87-40	\$99.00
83S87-16	\$75.00
83S87-20	\$75.00
83S87-25	\$75.00
2C87-8	\$49.00
2C87-10	\$59.00
2C87-12	\$59.00
2C87-20	\$69.00
3C87-20	\$79.00
3C87-25	\$79.00
3C87-33	\$79.00
3C87-40	\$95.00
3S87-16	\$69.00
3S87-20	\$69.00
3S87-25	\$69.00
80C287-10	\$35.00
80C287-12	\$69.00

SIMM MODULES

IBM TYPE	
ADD \$2.00 FOR SIPPS	
4Mx9-80	\$105.00
4Mx9-70	\$107.00
1Mx9-60	\$35.00
1Mx9-10	\$30.00
1Mx9-80	\$35.00
1Mx9-70	\$36.00
256x9-70	\$10.00
256x9-10	\$9.00
256x9-80	\$10.00
256x9-60	\$12.00
APPLE-MAC	
1Mx8-70	\$32.00
1Mx8-10	\$27.00
1Mx8-80	\$30.00
4Mx8-80	\$95.00

DRAM

DRAM 1MGX1	
1 MGX1-120NS	\$3.00
1 MGX1-100NX	\$3.50
1 MGX1-80NX	\$3.60
1 MGX1-70NX	\$3.65
1 MGX1-60NX	\$3.75

DRAM 64X1	
4164-150	\$0.85
4164-120	\$0.95
4164-100	\$1.50
4164-80	\$2.00
DRAM 64X4	
4464-15	\$1.50
4464-12	\$1.99
4464-10	\$2.50
DRAM 256X1	
256X1-150NS	\$0.85
256X1-120NS	\$0.89
256X1-100NS	\$0.99
256X1-80NS	\$1.10
256X1-70NS	\$1.20
S56X1-60NS	\$1.25
DRAM 256X4	
256X4-100NS	\$2.95
256X4-80NS	\$3.00
256X4-70/60NS	\$3.50
256X1-STATIC COL	
51258P-10	\$0.99
AAA 2800-08	\$1.29
AAA 2800-07	\$1.35
AAA 2800-60	\$1.55
1X4-80 ZIPP	\$14.00
1X4-80STT ZIPP	\$16.00
1X4-70STT ZIPP	\$17.00

SYSTEM

486-33 w/ 64k cache	
• 4MB RAM • 1.2 & 1.44 • 130 HD	
• VGA • SVGA 28 Monitor • 101 KB	
• Mini-Tower Case • DOS 5.0	
\$1529.00	

MONITORS

VGA 41 14"	\$215.00
SVGA 28 14"	\$260.00
SVGA 28 14" Non-Int	\$310.00
SVGA 25 14" Non-Int	\$510.00
SVGA 28 17"	\$775.00

MOTHER BOARDS OK

486-33 w/ 256k cache	\$595.00
486-33 w/ 64k cache	\$509.00
486SX-20/25	\$239/269.00

386-33 w/ 64k cache	\$209.00
386-25 Non-cache	\$220.00
386SX-16/25	\$105/135.00

MEMORY BOARDS OK

Boca AT+	\$115.00
Boca XT or 30	\$115.00
Orchid 16/32	\$269.00
Orchid 8/16	\$159.00
Rampart	\$95.00
Simpli Ram	\$189.00
TI Ram PS/2	\$199.00

1X4 4X1 STATIC

514402-80 (1x4) STT, ZIPP	\$14
514400-80 (1x4) ZIPP	14
514400-80 (1x4) DIPP	15
514400-80 (1x4) SOJ	11
514100-80 (4x1) SOJ	11

CASES

Mini-Tower	\$70.00
Mid-Tower	\$89.00
Full-Tower	\$119.00
Desktop	\$95.00

HARD DRIVES

44MB, 28ms, IDE	\$185.00
89MB, 14ms, IDE	\$250.00
130MB, 15ms, IDE	\$319.00
210MB, 15ms, IDE	\$475.00

FLOPPY DRIVES

1.2MB, 5.25"	\$56.00
1.44MB, 3.5"	\$53.00

MODEMS

2400bps Internal	\$45.00
9600bps Internal	\$299.00

FAX/MODEM

9600bps Int/S/R Fax	\$79.00
2400bps Modem	\$99.00

LINKS 386 Pro Rivalled only

This all new LINKS 386 Pro version of our award-winning LINKS golf game offers many dramatic improvements that make playing LINKS 386 Pro more enjoyable – and gives you exciting new golfing possibilities!

Super VGA Graphics and 386 Power!

The new LINKS 386 Pro, featuring Harbour Town Golf Links, is the first golf game specifically designed for the graphic capabilities and computing power of your personal 386/486 computer system. SUPER VGA 256-color graphics at 640x400 resolution display breathtaking views of LINKS Championship Courses. Your friends won't believe that your computer looks so good!

A lot of listening went into LINKS 386 Pro.

Many of the new features and improvements were added in response to direct requests from LINKS users like you! An exciting new feature is our Unique Computer Opponent. Play a round of golf and save your game. The new LINKS 386 Pro recorded every shot you made. Send your game off to your buddy and he can play against you right on the screen, shot for shot, as if you were right there next to him! We've also included pre-recorded games from worthy opponents, statistics, a variety of game play modes and much, much more.

Over 345 combinations of Viewing Windows.

With the new LINKS 386 Pro you're not stuck with just one standard viewing window. With a few clicks of your mouse you can split the screen giving you a real-time reverse view of your shot to the green or add a scaleable top-view that displays the flight of your ball. Scorecard, club distance chart, terrain profile and other panels give you the flexibility to display what you want to view while playing and you can change your viewing setup at anytime!

ACCESS
SOFTWARE INCORPORATED

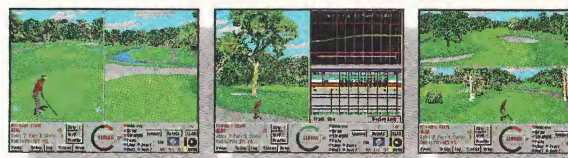
4910 W. Amelia Earhart Dr. • SLC, UT 84116
(801)801-359-2900 • FAX (801)596-9128

346 B Y T E • NOVEMBER 1992

Texturing of fairways, rough, sand, and other surfaces adds an extra level of realism.

Male and female golfers.

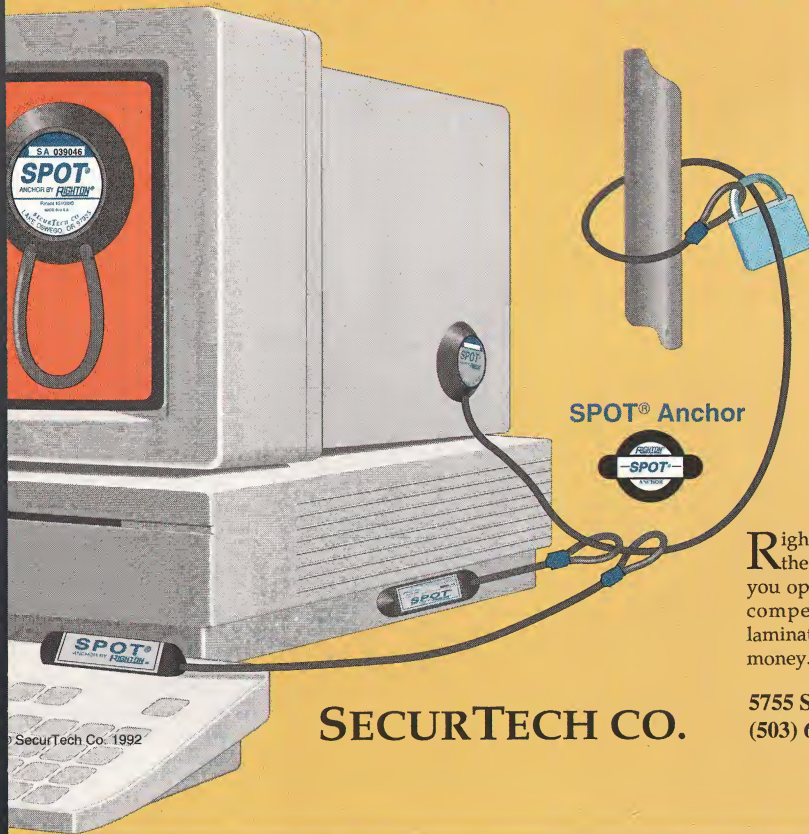
You can use any of the 7 existing LINKS courses or upgrade your favorite course to the Super VGA version.



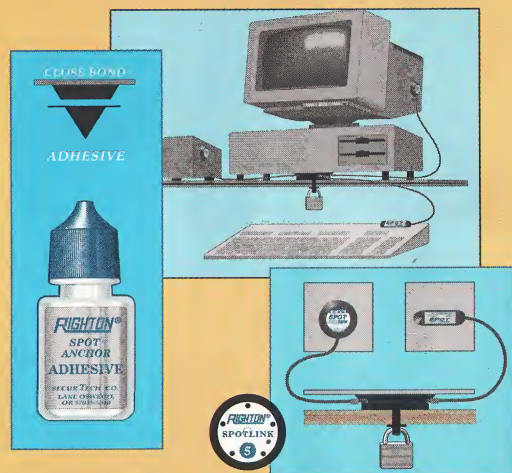
*Actual Links 386 Pro Super VGA Screen

RIGHTON® COMPUTER SECURITY

AFFORDABLE • EFFECTIVE • MOBILE



SPOT® Anchor



SPOTLINK-5®

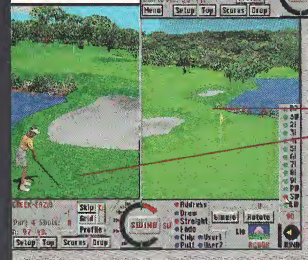
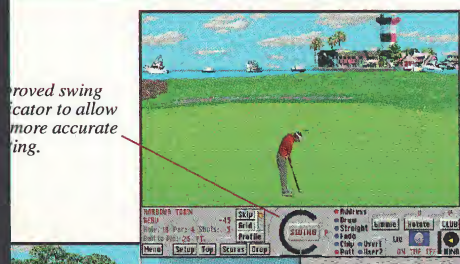
Righton® patented Spot® Anchors, with their special adhesive, are the best theft deterrents you can buy. Our versatile variety gives you options, easy access, and are easy to use. Spot-Link 5®, unlike competitors, is not dependent on the adhesive strength of a laminated top. Factory-direct prices from \$8.20 to \$32.50 save you money. Request our free brochure B with prices. Thank you.

5755 SW WILLOW LANE, LAKE OSWEGO OR 97035-5340
(503) 636-6831 • FAX (503) 636-9642

Made in U.S.A.

Circle 279 on Inquiry Card.

Play the game itself.



Real-time split screen views of your shot. Great for making your approach shot to the green.

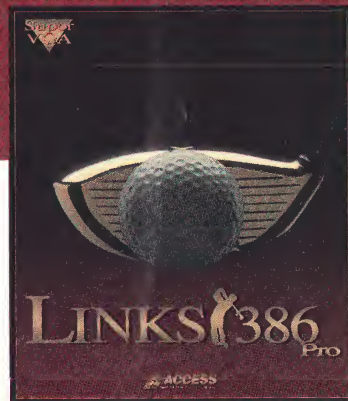
The Experience Continues...

The challenge doesn't end with Harbour Town. You can play each of the original LINKS Championship Courses (sold separately) with *LINKS 386 Pro*. Seven internationally-acclaimed golf courses on your desktop! Torrey Pines, Firestone South Course, Bay Hill Club, Pinehurst #2, Troon North, Dorado Beach, and Barton Creek with additional courses being released as fast as they are completed.

If you're a LINKS owner, you can purchase *LINKS 386 Pro* at a special introductory price. Call us today for more information.

1-800-800-4880

Call toll-free, 24-hours a day, Mon-Sat in the U.S. and Canada or visit your local software dealer.



NEW!

What Reviewers Are Saying about LINKS 386 Pro:

Strategy Plus:

"...with LINKS 386 Pro, Access has not so much pushed back the 'envelope' as redefined the term 'simulation.' Right from the opening screen it's clear that something special is happening here."

"...represents a new generation of computer game. Just play it and love it."

PC Entertainment:

"...for sheer, unadulterated realism, no golf simulation equals the performance of LINKS 386 Pro."

"...if you're serious about golf simulations, treat yourself to LINKS 386 Pro. And if you don't own a 386 to run it on, you've finally got a real good reason to lay out the money for an upgrade."

Computer Gaming World:

"...if you have a fast 386 or 486, think of LINKS 386 Pro as a Ferrari or a Corvette."

"...the ground texturing is dramatically realistic."

Key Features for Links 386 Pro!

• Seven different viewing windows, with over 345 different combinations.
• Improved club selection feature. • Wide, panoramic views giving you a better feel for the course. • Statistics recorded for each player, game and season, with optional print out. • A "Saved Shot" feature. • Scaleable "Top View". • "Profile View" which shows changes in elevation between the ball and the pin. • All new sounds! Supports SoundBlaster, SoundBlaster Pro, and other compatible sound cards & RealSound. • Improved swing indicator for more realistic putting. • Male or female golfers, with 10 different shirt colors to choose from. • Spectacular texturing of fairways, rough, sand, water not offered in other golf games.

Circle 292 on Inquiry Card (RESELLERS: 293).

NETWORK EXPRESS

CONNECT WITH US

MAKE THE DIFFERENCE! START YOUR LOCAL AREA NETWORK TODAY!

Whether you choose Artisoft (4 time winner of PC Magazine Editor's Choice), Novell Lite 1.1 (the latest version from Novell), or Silvernet (for those requiring Unix, OS/2, and Windows support), rest assured that you have selected the finest networking products made in the USA!



\$379.

IT'S YOUR CHOICE!

THE RIGHT CHOICE

After evaluating dozens of network interface cards, the engineers at Network Express selected the Alta EtherCombo for inclusion in our starter kit.

- 16 Bit ISA Adapter
- Auto Configures for 8 or 16 Bit BUS.
- BNC Fitting for Thin Coax
- RJ45 Fitting for 10 BASE T Twisted Pair
- 100% Novell NE-2000 Compatible
- Surface Mount Technology for Superior Reliability
- 4 Diagnostic LED's
 - Link - Verifies connection
 - T/R - Lights when data is moving
 - Collision - Indicates data collision
 - Polarity - Glows when wiring reversed
- Made in the USA
- 5 Year Warranty

Business Hours:
M-F - 8:30AM - 9PM EST
Saturday 10AM - 4PM

Address:
1611 Northgate Blvd.
Sarasota, FL 34234

Discover, VISA, MasterCard,
Diners Club, American Express,
Carte Blanche Accepted.
Never A Surcharge.

© 1992 Network Express

ARTISOFT LANtastic • NOVELL • SILVERNET
High Performance 2 Station Starter Kit
With Your Choice of Software

NETWORKING BREAKTHROUGH! COMPLETE 2 STATION 10MBS ETHERNET STARTER KIT INCLUDES:

- 2 - Copies of Artisoft LANtastic, Novell or SilverNET (Includes 2 sets of manuals)
- 2 - 16 BIT Ethernet Adapters
- 2 - 50 OHM Cable Terminators
- 1 - 25' Length of Cable (Longer lengths available)
- Additional Users - \$189. (Includes adapter card & software)



1-800-374-9899

24 HOUR TOLL FREE

FAX-1-800-333-5841-FAX

VOICE 1-813-359-2876 • FAX 1-813-355-5841

NETWORK EXPRESS
Networking To Go

Call Today For Our Latest Catalog
and a Complimentary Booklet
"Introduction To Networking."
FAXED TO YOU 24 HOURS A DAY
813-355-4301

Network Express Policies...

- 30 Day Satisfaction Guaranteed Evaluation Period. Sorry, but no refund can be made after 30 days from invoice date. Products must be in new condition with all manuals, boxes, and received materials. Opened software packages not returnable. RMA required.
- Full Manufacturer's Warranty on all products.
- Same Day Shipping & Overnight Delivery available on most orders.
- Government, Education, and Corporate Purchase Orders welcomed, subject to approval.
- Shipping Charges Not Refundable.
- Prices, Specifications & Availability subject to change without notice.
- We Export.

Novell, Netware, and "N" are trademarks of Novell. All other brand names are trademarks of their respective companies. Smart people read the fine print and they do business with Network Express.

AD #N118

LOST FOR THE WRITE WORD?

Get it right with **COLLINS ON-LINE**

French, German, Italian & Spanish bilingual dictionaries for your PC. 40,000 references, 70,000 translations

FEATURES INCLUDE:

- **TSR** - memory resident so it can be used with most word processors for MS-DOS.
- **Look-up** - enables you to find words in the dictionary, choose the appropriate translations and paste them into your document quickly and easily.
- **Screen-read** - reads words in your document automatically for quick and accurate translation.
- **Annotate** - allows you to create your own specialized glossaries for use with Collins' world renowned bilingual dictionaries.

PRICE £49 (Additional dictionaries £29)



HarperCollinsPublishers

14 Steep Lane, Finton, Worthing, West Sussex
BN14 0UF England

Tel +44 (0)903 873 555 • Fax +44 (0)903 873 633

Circle 355 on Inquiry Card.

Polaroid



Polaroid's Circular Polarizing Filters for computer monitors combine circular polarizer technology with optical quality materials and coatings to provide the ultimate in glare reduction and contrast enhancement. Polaroid CP-Filters suppress up to 99% of reflected light and are more effective than any other filter for improving contrast. Also, most CP-Filter models have a transparent electrically conductive coating which reduces up to 98% of the electromagnetic radiation and eliminates static.

Polaroid produces a full range of optical quality anti-glare filters in glass and triacetate to fit most 9"-21" monitors.

Polaroid Corporation, Polarizer Division,
N2, 1 Upland Road, Norwood, MA 02062
1-800-225-2770 Fax 617-446-4600

Circle 316 on Inquiry Card.

**YOU CAN SAVE
\$1000s
OF DOLLARS**

By Making One Easy Phone Call

Savings Line
900 Discount Shopper

1-900-680-3325

Call
1-900-680-DEAL
(1-900-680-3325)

NOW

We have shopped over 500 Direct vendors and our price information is the most up-to-date

If you are looking for any of these products we can SAVE YOU MONEY

- | | |
|---|-----------------------------------|
| 11. 486 Computers.....Pro or Nat | 24. Internal modems |
| 12. 486 sx Computers.....Pro or Nat | less than 9600.....Pro or Nat |
| 13. 386.....Pro or Nat | 25. VGA Monitors.....Pro or Nat |
| 14. 386 sx.....Pro or Nat | 26. Multiscan MonitorsPro or Nat |
| 15. 286.....Pro or Nat | 27. Color Monitors.....Pro or Nat |
| 16. Laptops.....Pro or Nat | 28. Laser Printer only Nat |
| 17. Notebooks.....Pro or Nat | 29. Ink Jet Printer only Nat |
| 18. Fax Machines only Nat..... | 30. Dot Matrix Printers only Nat |
| 19. Fax Boards.....Pro or Nat | 31. Hard Drives — 20-39 meg |
| 20. VGA Boards.....Pro or Nat | 32. Hard Drives — 40-59 meg |
| 21. EXT 9600 Modems.....Pro or Nat | 33. Hard Drives — 60-79 meg |
| 22. EXT less than 9600.....Pro or Nat | 34. Hard Drives — 80 meg plus |
| 23. Internal Modems 9600.....Pro or Nat | |
- You can select either national brands or proprietary for most categories. Call 1-900-680-DEAL(3325)

The charge is \$1.95 per minute and the average call lasts 4 minutes. You can receive your information by Voice Announcement on the same call or the information can be faxed to you within 2 minutes. Call us if you are a vendor and want to be listed or have any suggestions on how we can improve at 1-800-952-5280. Sponsored by The National Discount Shopping Advisory Board.

Complete Solution In One Card

SIGMA SIX™

96/24kbps send
Receive
Fax/Data
Modem

2 Serial, 1 Parallel Ports

NE 2000 LAN



Flash Disk!™
(Flash Eprom)
256K or 512K

IDF/Floppy
Controller

SVGA
1024x768
Non-interlaced
Supports 24Bit
True Color
with 16.8
Million Colors

- Windows™ Accelerator—Windows 3.1/3.0 Compatible
- Software configurable interrupt lines (IRQ)—No hardware interrupts required. All functions can be enabled and disabled via software.
- Avoids Multi-board incompatibilities.
- Saves time and money.
- 30 days money back guarantee.
- 2 years warranty-board replacement.
- **MADE IN USA**

AMT®

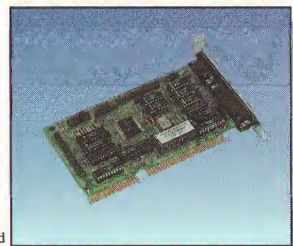
Advanced Micro Technology
123 University Pkwy
Pomona, Ca. 91768
Tel: (714) 598-6120 Fax: (714) 598-7716

Circle 345 on Inquiry Card.

2.88MB Solutions for DOSs and OS/2

FEATURES :

1. Support 2.88M/1.44M/720K/1.2M/360K floppy disk drives.
2. Compatible to DOS 3.x/4.x/5.0, OS/2 2.0
3. Formatting operation with DOS command.
4. Support 4FDD, 4FDD & 2HDD, 2FDD & 2HDD & 2S/1P
5. Can diskcopy 5 1/4" diskettes to 3 1/2" diskettes.
6. Can boot from any floppy drives.
7. Non DOS trapped switch for UNIX and CP/M OS.
8. Can exist with any other FDC and HDC.
9. Support 4Mb drives as TOSHIBA. TEAC old & new and PS/2 spec.



OEM and Distributor Welcome



CHIA SHIN TECHNOLOGY CORP

1F NO. 24, ALLEY 2, LANE 76, SEC. 6, SHIN YI RD. TAIPEI, R.O.C
FAX : 886-2-7270804
TEL : 886-2-7263869 • 7271861

Circle 353 on Inquiry Card (RESELLERS: 354).

**\$289 /kit
plus S & H**



EasyMount TOUCHSCREEN kit includes:

- A transparent flat touch plate, sensitive to pressure.
- A controller card, 4"x4" in size, fits into PC bus slot.
- Diskettes provide educational programs, demos, C-callable routines, keyboard and mouse emulators, calibration and coding examples.
- Mounting hardware allows touch screen to be used with most monitors
- Manual contains instructions for hardware installation, touch screen mounting, library function calls.

Hi-Tech Instruments, Inc., P.O. Box 1509, Stafford,
TX 77497-1509 Ph: 713 • 980 • 5040 Fax: 713 • 980 • 4251

Circle 306 on Inquiry Card.

Communications/Networking

PC/AT Four Port Com. Coprocessor

GMM Sync4/CCP™

- High Performance 16 MHz 16 bit CPU.
- 80X86 code compatible.
- 4 Sync/Async Ports (2 Serial Ports with Full Duplex DMA).
- Uses Zilog 85C30, 85230 SCC chip.
- 512K Dual Ported Ram (STD) (1, 2, or 4 MEG Dual Port Ram - optional).
- 8k, 16k, 32k, 64k Window Size (Programmable).
- 8 Software Selectable and Shareable Interrupts.
- RS232/RS422/RS485
- Source Code Debugger Kit Available.



GMM Products Are All Made in USA.

PC/AT Dual Port Com. CoProcessor
also available
GMM Sync2/CCP™

GMM
GMM Research Corporation

Other PC/AT & PS/2 8530 based products available.
Extremely competitive pricing.

(714)752-9447 Fax (714)752-7335
18092 Sky Park South - Unit E, Irvine CA 92714

Circle 302 on Inquiry Card.

Communications/Networking • Computer Systems

LET YOUR COMPUTER DO THE TALKING!

Integrated Voice/Fax Mail

integrates major voice/fax applications plus program control into one full-featured high performance software. PC-AT/386/486 based. Menu driven. Easy to use. Full support for Rhetorex, New Voice, Dialogic, TTI and Intel voice and fax hardware. Supports up to 24 voice lines and up to 8 fax lines.

Hardware + Software
4 voice lines package starts at **\$950**

Tel: (818) 368-6132 Fax: (818) 368-7859

SigmaTech Software

24 hours demo lines: 818-368-4566 or 818-368-8848
10801 Bismarck Ave., Northridge, CA 91326 USA
(Resellers/Dealers/OEMs/Private labels are welcome)

- Auto-Attendant
- Unlimited Audiotext
- Voice Mail
- Call Processing
- Telemarketing
- Fax Mail
- Fax-on-Demand
- Fax Broadcasting
- Party/Chat lines
- Talking Yellow pages

Circle 349 on Inquiry Card (RESELLERS: 350).

NEW!

GTEK INC. PCSS-8FX

Ultra High Speed Serial Coprocessor



Fast

- 1 Megabyte/Sec transfer speed.
- No load on Host Processor.
- I/O mapped - No host memory used.
- 8 ports per card.
- RS-232/RS-485/RS-422.

Order Toll-Free 800-282-4835

GTEK, Inc., Hardware & Software Development • P.O. Box 2310
Bay St. Louis, MS 39521-2310 USA • Mississippi & Technical Support 601-467-8048
Fax: 601-467-0938 • OEM & Dealer Inquiries Welcome!

Circle 304 on Inquiry Card.



BLAST

YOUR MESSAGE THRU!

Voice Mail • Telemarketing • Call Processing

Transform your PC/XT/AT/386 into a multi-line processing command center. intelligently process your sales, inquiries, and messages. Complete package.

Multi-Line (Voice Solution) \$995
SINGLE LINE (Bigmouth) \$295

For Sales or Information:
Call 1-800-685-4884

CALL: (510) 522-3800 • FAX: (510) 522-5556

TALKING TECHNOLOGY, INC.
1125 ATLANTIC AVE. • ALAMEDA, CA 94501

©1992 TALKING TECHNOLOGY, INC.
(Developer/OEM packages available)
VISA—MC—AMEX—COD

Circle 321 on Inquiry Card.

FREE CATALOG

Contains 284 pages of quality tools and tool kits, service diagnostics and test equipment for maintenance of computers and communication systems. Also LAN products: cables, taps, connectors, transceivers, repeaters, assemblies, and more. Free shipping, free technical support, 100% guarantee.

JENSEN®

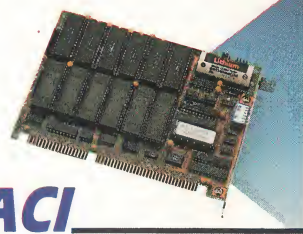


Jensen Tools Inc.
7815 S. 46th St., Phoenix, AZ 85044
(602) 968-6231 • Fax (800) 366-9662

Circle 309 on Inquiry Card.

SSD-2HD Intelligent Solid-State Disk

- 1.44MB max. FLASH/EPROM Disk w/auto-boot
- 1.44MB max. SRAM Disk w/battery backup
- Auto-sense installed FLASH/EPROM /SRAM memory types
- Auto-configure Solid State Disk Drive
- Software protection key(PARAKEY) designed to protect a specified software application from unauthorized use.



ACI
1-800-886-ACI-3

U.S.A.
TEL: 617-938-8020
FAX: 617-938-8037

International
TEL: 886-2-7582571(Taiwan)
FAX: 886-2-7589615

Circle 343 on Inquiry Card (RESELLERS: 344).

Intelligent PrintShare SPECIAL OFFER - STARTER KIT

Everything you need to share your printer with two computers is included. (1) printer transmitter, (2) computer receivers, (2) 25 ft interconnect cables and a manual. Allows expansion up to 40 computers. Employs collision avoidance technology, intelligence detection, auto switching, no software required. Any topology wiring, uses popular 4 wire modular cables. PrintShare Kit as described \$239.50 + \$4.50 S&H. Additional computer adaptors with 25 ft. cable \$79.50, PP. Toll free ordering: 800-343-1455.



Call or fax for further information on this and also multi printer PrintShare network systems.

Call for FREE catalog!
Specify - BYTE

AGENTS WANTED

L-com

Inc. TEL: 508-682-6936 FAX: 508-685-6467
1755 Osgood Street, North Andover, MA 01845

Circle 337 on Inquiry Card

AT Systems in ROM

- Single Board Computers
- Run DOS code from ROM
- PC Code compatible
- Large Memory space
- Backplane systems
- Develop code on a PC. Run on our CPU cards with DOS and code in ROM. Use off-the-shelf expansion cards.
- KS6: NEC V53 CPU (286eq), 5 serial, 2 Par, Clock, AT bus, Max 4M Ram, 2M Rom, 512K NV Sram. \$349 (q1-oem ver).
- KS3: V40 CPU, 3 Serial, 2 Par, Clock, Flop, Kbd. \$249 (q1).



303-444-7737 Fax 303-786-9983
655 Hawthorn Ave., Boulder CO 80304 U.S.A.

KILA

Circle 310 on Inquiry Card

Rackmount Solutions

RACKMOUNT COMPONENTS - QTY 25 PRICING

Rackmount Chassis 19"x7"x17"	\$183
Rackmount VGA Monitors	\$531
Rackmount Monitor Shelf	\$113
Rackmount Keyboard Shelf	\$88

RACKMOUNT PLATFORMS - Qty 1 Pricing

RMS286-12	\$549	RMS386-33	\$1095
RMS386SX-16	\$795	RMS486-33	\$1695

System Platforms include 7" Rackmount Chassis, 200W Power Supply, Motherboard, 1.0MB Memory, IDE, FD, 2-Ser, Par, 1.2MB or 1.44MB Floppy Disk Drive, 1 Year Warranty

RACKMOUNT CHASSIS - 15 Models up to 20 Board Slots
SLOT CPU BOARDS - 486, 386, 386SX, 286

RACKMOUNT MONITORS - Super VGA and Monochrome
RACKMOUNT CABINET - Modular from 21" to 96" high

VALLEY
TECHNOLOGY INC.

2468 Armstrong Street, Livermore CA 94550
(510) 447-2030 FAX: (510) 447-4559

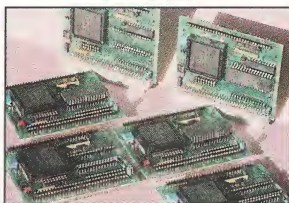


Circle 332 on Inquiry Card.

EMBEDDED COMPUTERS

Everything you want

- ☐ Powerful Hitachi H8/532 16-bit processing
- ☐ Drives graphics LCDs and keyboard
- ☐ Collects 10-bit analog data from 8 channels
- ☐ Stores information on PCMCIA Cards
- ☐ 16K Forth and ready-made solution library
- ☐ High level interrupts and multitasker
- ☐ \$325 qty 10+ \$249 qty 100+



.... to make life easier



For more information contact:

The Saelig Company Tel (716) 425-3753 Fax (716) 425-3835
Outside USA & Canada: Triangle Digital Services Limited
223 Lea Bridge Road, London Tel 081-539 0285 Fax 081-558 8110

Circle 323 on Inquiry Card.

HANDYSCOPE 12 bits
COMPUTER-CONTROLLED
MEASURING INSTRUMENT

- STORAGE OSCILLOSCOPE
- SPECTRUM ANALYZER
- VOLTMETER
- TRANSIENT RECORDER

TiePie engineering

CALL for FREE demo diskette and information NOW:

COMPLETE SYSTEM \$499!

TIEPIE engineering

Tel: (31) 5106 238 Fax: (31) 5106 704

Battensereed 2, 9023 AR Jorwerd
The NETHERLANDS

The HANDYSCOPE is a unique data acquisition instrument to be connected to the printer port of the computer (desktop, laptop, notebook), without external power supply. HARDWARE: 12 bits 100KHz; Sample & Hold, PGA (0.5-2.5-10 and 20 volt), two switchable probes (1:1, 1:10). Data acquisition SOFTWARE: two channel storage oscilloscope, spectrum analyzer, voltmeter, transient recorder.

Circle 333 on Inquiry Card.

100 MHz
IBM PC-BASED
OSCILLOSCOPE CARD

- Supports PC/XT, AT, 386, 486
- Up to 100 MHz sample rate
- Up to 8 Megabyte Memory
- Up to 16 channels
- FREE menu-driven software
- Drivers in C, Pascal & BASIC
- GageScope software support
- Made in North America
- Waveform Generators also available



CSLITE (40MHz/16K)	\$595
CS220 (40 MHz /256K)	\$1,995
CS250L (100 MHz)	\$2,750
CS250 (100 MHz / 32K)	\$3,500

CALL (514) 337-6893

Gage Applied Sciences Inc
5465 Vanden Abeele
Montreal, Quebec
Canada H4S 1S1
Fax: (514) 337-8411

Gage

Circle 299 on Inquiry Card (RESELLERS: 300).

Connect with the Parallel Universe
SIGEN 250MB PORTABLE PARALLEL PORT TAPE BACKUP

No controller card required. Connects to parallel port. Installs in less than 3 minutes. Great for Laptops. To 9.5 MB/min transfer rate.

Capacity

20 MB Parallel Port Floppy
80/250 MB 1/4" cartridge 4.5 MB/min
60/200 MB 1/4" cartridge 9.5 MB/min
250/500 MB 1/4" cartridge 9.5 MB/min
1.3 GB 1/4" cartridge SCSI 18 MB/min
1.2 / 2 GB 4mm DAT SCSI 10MB/min

Supports

DOS, OS/2
Novell 286, 386
UNIX, XENIX

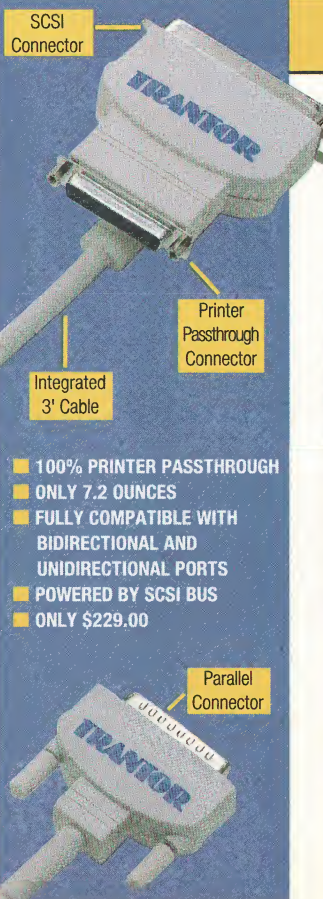


Industry standard SYTOS PLUS, or CENTRAL POINT BACKUP software and for file server based NLIM and VAP TAPEWARE.



PHONE (408) 737-3904 • FAX (408) 737-3910

Circle 322 on Inquiry Card.

MiniSCSIplus
PARALLEL-TO-SCSI ADAPTER

WANT BETTER CONNECTIONS?

CONNECT UP TO 7 SCSI DEVICES AND A PRINTER TO YOUR PARALLEL PORT!

Up to twice as fast as our original MiniSCSI, the MiniSCSI Plus lets you run a CD-ROM, tape drive, SCSI hard disk, SyQuest, Bernoulli or other SCSI device from almost any parallel port (tape software optional). For most notebook users, it's the only way to use SCSI CD-ROMs and tape drives. Plus, its integrated cable makes it a snap to move and share SCSI devices between desktops and notebooks.

Call For Details!
(510) 770-1400



Trantor Systems Ltd.
5415 Randall Place
Fremont, CA 94538-3151
FAX: (510) 770-9910

© 1992 Trantor Systems Ltd. MiniSCSI and MiniSCSI Plus are trademarks of Trantor Systems Ltd. All other product names are trademarks of their respective companies.

Circle 331 on Inquiry Card.

THINK!

M.S.-PRO vs. Wireless

What works better than a wireless mouse and is affordable by everyone?
Introducing the first peripheral for your mouse!



Patent pending

Introducing the M.S.-PRO
The Mouse Station PRO eliminates all cord association problems and provides the user with total freedom of movement over the entire workspace!
The M.S.-PRO comes with its own proportional mouse pad.

M.S.-PRO

- No batteries
- No loss of resolution
- No interference
- No high cost
- No maintenance
- No loss of sensitivity
- No cord snagging
- Lifetime guarantee

Wireless Mouse

- Battery-dependent
- Expensive
- Loss of Resolution
- Loss of Sensitivity
- RF type can cause interference to your monitor and other electronic equipment.
- IR type are limited in direction and distance.

ABOUT IT!

Then order yours today!

M.S.-PRO **\$19.95** (shipping & handling \$2.95)

C.P. Research to order, call **207-622-1867**
126 Western Avenue, Suite 169, Augusta ME 04330

Circle 362 on Inquiry Card (RESELLERS 363).

Industrial PC Solutions

RELIABLE, AFFORDABLE, FLEXIBLE

- Industrial PCs
- Industrial I/O Cards
- 286/386/486
- PC-Bus Card Cages
- CPU Cards
- Rack Mount
- RAM/ROM Disks
- Keyboards

1-800-800-6889
(In California 408-293-6786)

Industrial & Lab Automation with PCs
ADVANTECH

1310 Tully Road, #115, San Jose, CA
FAX: 408-293-4697

Total Solutions for PC-based
Industrial Automation and Control



FREE! New 140-page
PC-based industrial
automation reference
guide for your system and
OEM needs.

Circle 296 on Inquiry Card.

Specialist in Industrial PC Modules for OEMs



- Industrial Single Board PCs: 286, 386SX, 386DX and 486DX CPU Cards, 6 layers, low power consumption, 60°C operating temperature, watchdog timer, 2S/1P ports, HDD/FDD interface and piggyback connector for RAM/ROM Disk Module.
- RAM/ROM Disk Card/Module: 1.44MB x 2, SRAM or EPROM
- PC Bus Passive Backplanes: 6, 8 and 12 slots.

Fax us to order our FREE CATALOG and obtain OEM pricing info.



AAEON TECHNOLOGY INC.
FL2, NO. 41, Jin-Wen Street,
Jin-Mei District, Taipei, Taiwan, R.O.C.
Tel: 886-2-218-1568 Fax: 886-2-218-2463

Circle 294 on Inquiry Card (RESELLERS: 295).



Memory Superstore . . . your direct source.

For the absolute best price & service call (800) 800-7056.

Standard SIMMS

4MB x 9-80/70 ***	\$110.00
4MB x 9-60	\$114.00
256K x 9-80/70	\$11.00
1MB x 9-80/70 (9 chip)	\$34.50
1MB x 9-80/70 (3 chip)	\$31.00
1MB x 36-70*	\$136.00
2MB x 36-70*	\$262.00
4MB x 36-70* ***	\$499.00

Call for best price on a 30-pin & 72-pin
Modules, 2, 4, 8 & 16MB

*used in PS/2, Compaq, Dell &
other high-end systems (386 & 486)
*4 piece minimum

Laser Printer Memory

Canon	1MB	\$118.00
LBP 8II/8IIR/8IIT	4MB	\$190.00
Epson Action Laser	2MB	\$125.00
Action Laser II	2MB	\$138.00
HP LaserJet IIP, IIPPLs, IJ, IJL, IJL, IJL, IJL, IJL	2MB	\$99.00
HP DeskJet	256K	\$78.00
IBM 4029 ***	4MB	\$140.00
Sharp JX9500PS	1MB	\$75.00
OKI Laser OL400	2MB	\$116.00
OL800/820	2MB	\$135.00
	4MB	\$210.00
	2MB	\$135.00

Panasonic

KXP4420, 4450I	2MB	\$175.00
KXP4455	4MB	\$215.00

IBM & Compaq Memory

PS/2: 35SX/LS, 40SX, 50Z, 55SX/LS, 57SX,		
65SX/LS, 70, 70A21, B21, B61, 90, 95		
2MB \$89	4MB \$136	8MB \$268
DeskPro386/20, E, 25, S/16, N, SX20, 33M		
2MB \$89	4MB \$136	8MB \$268

Workstation Memory

Sun EPC/IPX ***	16MB	\$470
Dell 486	16MB	\$495
IBM RS6000	16MB	\$620
HP Apollo	16MB	\$675
Silicon Graphics	16MB	\$620
Next	16MB	\$470

Specialists in workstation products. Contact
us for current prices & new catalog.

Laptop/Credit Card/Flash Memory

Apple Power Book ***	4MB	\$230
AST Premium Exec.	4MB	\$160
AT&T Safari	4MB	\$345
Bondwell B310	1MB	\$136

Compaq

LTE386s/20	1MB	\$82	4MB	\$259
LTELite/20.5	2MB	\$140	4MB	\$240
	8MB	\$578		
LTE/286	1MB	\$88	2MB	\$138
SLT/286	1MB	\$88	4MB	\$240
Goldstar GS520	4MB			\$330

HP 95LX, Poget PC, Grid Pad		
SRAM Card	256K	\$122
	512K	\$149

Flash Memory	1MB	\$238
	2MB	\$309

Packard Bell, Magnavox, Mitsuba ***		
	2MB	\$150
	4MB	\$290

Toshiba - T1000SE/LE/XE, T2000SX,		
T1000LE, T2200-SX, T2000SX		
	1MB	\$80
	2MB	\$109
	4MB	\$230
	8MB	\$430

Toshiba - T1200XE	2MB	\$88
-------------------	-----	------

Toshiba - T4400 SX/SXC, T3300, T6400		
	2MB	\$182
	4MB	\$329
	6MB	\$469
	8MB	\$670

Zenith Masters SL	2MB	\$122
-------------------	-----	-------

Memory Superstore (800) 800-7056

OR (805) 339-0305
FAX (805) 339-0353
Small Business
Volume Discounts for Corporations,
VARS, Government and Universities.

Circle 335 on Inquiry Card.

MEMORY UPGRADES

CALL FOR BEST PRICE ON MEMORY GRADES FOR:

Laptops • Notebooks • Palmbooks • Memory Cards • Laser Printers • Brand Computers

ACER ALR Apple AST AT&T BONDWELL
COMPAQ DATAGENERAL DEC LEADINGEDGE EPSON EVEREX
GATEWAY NEC SILICON GRAPHICS MAGNAVOX MITZUBA
NCR HEAVYMET PACKARD BELL DELL Panasonic Canon
IBM SUN MICRO TANDY TOSHIBA Zenith ZEOS

MATH CO-PROCESSORS

DYNAMIC RAM

SIMMS & SIPPS MODULES

BIOS UPGRADES

STATIC & VIDEO RAM • ZIPS

XT SYSTEMS	\$24.75
286 SYSTEMS	\$49.75
386 SYSTEMS	\$78.75

USA ELECTRONICS, INC. 1-800-332-8434
9090 N. STEINMONS FWY. • DALLAS, TX 75247 We acknowledge all trademarks.

Circle 357 on Inquiry Card.

IBM • TATUNG • PANASONIC • ZEOS • SHARP • NORTHGATE • HYUNDAI • AST • SANYO • LEADING

ROM BIOS UPGRADES

Solve Your Compatibility Problems!

AMI PHOENIX MR BIOS AWARD Solutions for all your upgrade needs
WE STOCK THE LARGEST VARIETY OF
ROM BIOS UPGRADES IN THE WORLD

FEATURES OF A NEW BIOS

• Support, 12MB, 1.44MB & 2.88MB floppy drives • Windows 3.1 support • Novell support • DOS 5.0 Support • IDE drive support • OS/2 support • Support for 47 different hard drives, plus 2 user defined • Virus & password protection • and more!!

SMARTMICRO TECHNOLOGIES
INC.

FREE Catalog FREE Chip Puller FREE Tech Support
ORDER TOLLFREE 800 266-1576
Fax (805) 371-0012 Tel (805) 371-0055

143 TRUNFO CANYON ROAD, SUITE 103
WESTLAKE VILLAGE, CALIFORNIA 91361

WE WILL BEAT ANY COMPETITORS PRICE !!

D • GATEWAY • EPSON • TANDY • DELL • NCR • EVEREX • COMPAQ • NEC • WYSE

Circle 342 on Inquiry Card.

UPGRADES, ETC.YOUR UPGRADE SOURCE
ACCESS ALL THE NEW TECHNOLOGY**ROM BIOS UPGRADES**MR BIOS-KEY BOARD BIOS.
MR BIOS-OPTI 386/486

AMI-IBM XT

AMI-286 for DTK

AMI-286 for IBM

AMI-386 C&T

PHOENIX-COMPAQ286

MANY MORE IN STOCK!

**BLOWOUT
PRICES!**CALL FOR
BEST PRICE!**Alpha Research Local Bus**

MAINLINE486 Local Bus Motherboard. Supports

486SX up to 486-50MHz. Kit w/1832bit video

ond32IDE Cache, Controller w/CPU. \$999

Call for prices with CPU

MEMORY UPGRADES

1X9 80NS SIMM.....\$37 70NS SIMM.....\$38

4X9 80NS SIMMS.....\$142

Pan. KXP 4410, 4430 2MB.....\$105

Pan. KXP 4420, 4450 2MB.....\$129

Hewlett Packard / IBM Laser Printers

OTHER MANUFACTURERS AVAILABLE

TTI MOTHERBOARDS

TTI-286 20MHz.....\$90

TTI-386SX 33MHz.....\$175

TTI-386 40MHz w/64K Cache.....\$325

AMI Boards/EISA MBS available Call

Call Us First For All Your Upgrade Needs

BIOS, Memory, Motherboards

Free Technical Support Free Catalog

WE WILL NOT BE UNDERSOLD!

MC/VISA/AMEX/DISC/COD

UPGRADES, ETC. 800-955-3527

24 Hr. FAX Order Line (805)650-6515

2432-Palma Dr. Ventura, CA 93003

805/650-2030 Corp. & University P.O.s Welcome

Prices subject to change without notice. Terms and conditions available upon request.

THUNA TECHNOLOGIES

Circle 326 on Inquiry Card.

**Prevent 486 CPUs From Overheating
With AVC Cooling Caps**

This new patented series of products is available for the latest powerful CPU specifications. Each model is designed for easy installation and removal.

model	Target CPU	L×W×H (mm)
HSF4013AL1	486DX-33 DX-50	49.5×49.5×23
HSF4010BL1	486DX-50 DX2-66	49.5×49.5×20
HSF4010BL1	486DX-33 DX-50	49.5×49.5×13.7
HSN0FANL1	486DX-50 DX2-66	49.5×49.5×9.5
HSN0FANL3	Notebook	52.0×52.0×15
HSN0FANH1	486DX-33 DX-50	
HSN0FANH3	586DX	

U.S. Patent Pending NO.07/903-130

AVC**ASIA VITAL COMPONENTS CO.,LTD.**

3F-9 No. 1, Wu-Chuan 1 Rd. Hsin-Chung City,

Taipei Hsien, Taiwan, R.O.C.

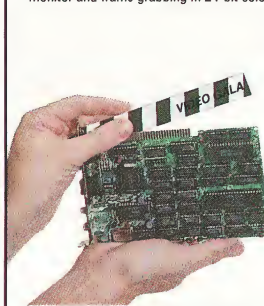
TEL : 886-2-2996930 ~ 32 FAX : 886-2-2996929

Circle 360 on Inquiry Card (RESELLERS: 361).

VIDEO FRAME GRABBERS

RECORD TO VCR AND TV MONITORS. PC/XT/AT, PAL/NTSC

VGA VIDEO GALA\$695.00 Three boards in one: 1) It's a Super VGA card which replaces your existing card. 2) It has recordable output to VCRs & TVs. 3) Live TV/VCR video on your VGA monitor and frame grabbing in 24-bit color.



HRT 512-8.....\$995.00 Real time, grey scale frame grabber. This is a multifunction high performance industrial model. (LUT, overlay, external trigger, EX/IN. pixel clock, genlockable, optional square pixels, video output...) Applications include machine vision, medical imaging, robotics, microscopy etc. Resolution is 512 X 512 with 256 levels of grey (optional 2nd buffer or 640 X 512 res). Rock-solid capture even from a VCR. Library of Image processing routines included free. 100+ functions such as histograms, convolutions, edge detection, point and area operations, arithmetic and logical operations between frames, board control, IO, etc.

**HIGH RES
TECHNOLOGIES INC.**

P.O. Box 76, Lewiston, New York 14092 U.S.A.

Tel: 416-497-6493 Ext. 105 Fax: 416-497-1636 Dept. 105

Circle 305 on Inquiry Card.

SuperSound™Digital Audio Authoring
Workstations \$179 up.**Developers: Create Special
Sounds for Windows / DOS**

- LIKE HAVING A CASSETTE TAPE RECORDER IN A PC.
- Fastest, easiest Editors - most features for the price.
- Quick, simple hardware / software installation.
- Use for FOREIGN LANGUAGE training / communications.
- Use for Engineering, Function Generators, Alarms, etc.
- DOS Extender version - Up to 16 MB working space.
- Complete Technical Support: Help on Digital Audio
- HARDWARE / SOFTWARE - NO extra charge!

LOW-COST DIGITAL AUDIO for LAPTOPS
USA Made - Pro Quality, 30 Day Money-Back Guarantee

by Silicon Shack Ph: 408-446-4521 Fax: 408-446-5196

4760 Castlewood Drive, San Jose, CA 95129

Tech. Info: 800-969-4411 Ask for FREE Product Catalog

OEM DEVELOPERS: ADD QUALITY AUDIO HARDWARE TO YOUR PROJECT

TV SuperSound, Sound-In, SoundFX-Pro are trademarks of Silicon Shack, Ltd. (Some prices may vary slightly)

Circle 320 on Inquiry Card.

Make Your Image Fly !

Capturing, Compression and Printing.

Video Blaster, Full Motion, True Color, Windowing Video
Capture & Sound Controller

- *3 Switchable NTSC/PAL Video Inputs
- *720x512 Digitized Video Resolution
- *D/A Sound Mixer & Volume Control
- *Mixed Amplified Stereo Output of 0.5W
- *Versatile Utility for Captured Video Image Manipulation, Editing, Storage, Retrieval



- *Windowing controlled by Independent X-Y coordinates & by Color Keying
- *Independent X-Y Scaling
- *Lots of Bundled Software!
- *MS-Dos & Windows 3.X
- Dynamic Link Library Available

\$349**Picture Packer**, 30:1 Image Compression Software
for Windows 3.0

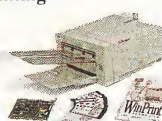
- *Dramatically Saves Precious Hard Disk Space by 30:1 with Minimum Image Quality Loss and 5:1 with NO Image Quality Loss
- *Supports Full Color or Gray-Scale Image Files
- *Supports Windows 3.0 and MS-DOS 5.0
- *Adheres to JPEG Standards
- *Compatible with All Major Graphic File Format: TIFF, TARGA, PCX, GIF



- *Memory-Resident Program Operates. Transparently within Popular Applications such as: Aldus Pagemaker, PhotoStyler, Picture Publisher
- to automatically Access and Decompress Picture Files.
- *Affordable Price of \$99.00 with \$99.00 Coupon Toward Purchase of Packer Card

WinPrinter, Cost Effective 800 DPI Laser Printing

- *Host-Based Processing. The More Powerful Your Computer. The Faster the Printing Speed.
- *Made for Windows Printing
- *Printing Versatility - 3 Ways with: Windows Direct Driver, PostScript Emulator, PCL4
- *800 DPI Laser Printing, 4 Page-Per Minute
- *Upgrade Kit for your HP LaserJet Series Printers Available



For Order, Catalog and Price Quotes Call:

1-800-446-1967Mon - Fri
9am - 5pm**Empire Computech**9668 Hermosa Ave.
Rancho Cucamonga, CA 91730
Tel: 714-466-1400 Fax: 714-466-1409

All trademarks are trademarks of their respective owners.

Circle 347 on Inquiry Card.

PLC
"High speed scan rate at a fraction of the cost"
HARDWARE:

- 8 optically isolated digital inputs at 12 or 24 VDC
- 8 isolated relay outputs rated at up to 3A continuous at 120 VAC with a 10 A surge
- SIZE: (9" L x 3.5" W x 1.5" D) • 108 internal bits • 8 K of EPROM
- up to 1ms per K of boolean logic • serial communications optional

100 GENERAL PURPOSE REGISTERS: used for

- timers • counters • pulsars • data storage • sequencers

SOFTWARE:

- programmable with IBM XT/AT/386/486 compatible and EPROM programmer
- ladder logic • text annotation • easy to use editor with menus and function keys

hardware \$139.00 software \$99.00 both for \$188.00

1-800-668-2707 tel: (519) 681-2818 fax: (519) 681-9822

DAVISON • WORTH
CORPORATION

Circle 351 on Inquiry Card (RESELLERS: 352).

IEEE 488.2 for Notebook PCs

- Attaches to the PC's parallel printer port
- Controls up to 14 IEEE instruments
- Transfers data at up to 170 Kbytes/sec
- Includes DOS or Windows software drivers
- Graphics & analysis software available
- Allows parallel & IEEE devices to be connected simultaneously

Call or fax for more information:

**Tel (216)-439-4091
Fax (216)-439-4093****iOtech**

the smart approach to instrumentation

iOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146



Circle 307 on Inquiry Card.

Programmable Hardware

IEEE 488/Serial Converters & Controllers

Connect IEEE 488 (HP-IB/GPIB) and serial (RS-232 or RS-422) computers, plotters, and instruments



IOtech

the smart approach to instrumentation

IOtech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146
(216) 439-4091 • Fax (216) 439-4093

Circle 308 on Inquiry Card.

MetaLink Corporation Melts the Price of 8051 ICE

Only \$851 for iceMASTER-PE

New AET (patent pending) emulator architecture delivers incredible value!

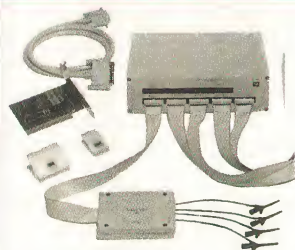
- Up to 40 MHz Operation
- 64K Emulation Code Memory
- 64K External Data Memory
- 128K Hardware Breakpoints
- 16K Trace Memory
- Transparent Trace (View Trace While Executing)
- Real Time & Nonintrusive
- Symbolic & Source-Level Debug
- Built-In Self-Test
- Windowed User Interface
- Serial Link to Any PC
- Performance Analyzer
- Macro Cross Assembler
- Supports 8031/8032's
- Supports 8XC751/8XC752's

Call today for FREE DEMO DISK! **(800) 638-2423**

MetaLink Corporation P.O. Box 1329 Chandler, Az 85244-1329
Phone: (602) 926-0797 FAX: (602) 926-1198

Circle 338 on Inquiry Card.

200 MHz Logic Analyzer



- 400 MHz max sampling rate
- up to 128 channels
- 16K samples/channel
- 16 level triggering
- Variable threshold voltage
- Sophisticated triggering
- FREE software updates

\$799 - LA12100 (100 MHz)

\$1299 - LA32200 (200 MHz-32-ch.)

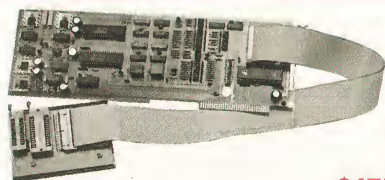
\$1899 - LA32400 (400 MHz-32-ch.)

Price is complete.

Pods and software included.

Universal Programmer

PAL
GAL
EPROM
FLASH
EEPROM
PROM
87xxx...



\$475

- 16V8, 20V8, 22V10, GALs
- 26V12, 20RA10, 18V10 GALs
- 2716-27040 EPROMs
- 87xxx MICROS
- EEPROMs (incl. 8 pin serial)

- 16 bit EPROMs
- Byte Split/Merge (16 & 32 bit)
- JEDEC, INTEL HEX, Motorola 'S' files
- Dallas NVS RAM programming
- FREE software updates on BBS

Call - **(201) 808-8990**

Link Computer Graphics, Inc.

369 Passaic Ave., Suite 100, Fairfield, NJ 07004 FAX: 808-8786

Circle 312 on Inquiry Card.

Programmable Hardware • Tape Drives

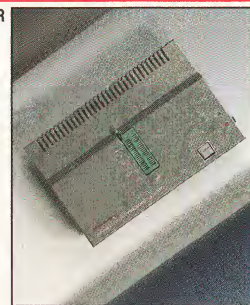
UNIVERSAL PROGRAMMER, EMULATOR, & TESTER

TUP-400 \$745.00 NEW

TUP-300 \$575.00

- New Improved hardware and software.
- The most complete PC-based Universal Programmer, Programs PLD (PAL, GAL, FPL, EPLD, PEEL, MAX, MACH...), E(E)PROM, (up to 16Mbit), Flash EPROM, BPROM, Special PROM, MPU (87XX, 68XX, Z8, PSD301, PIC16XX, TMS320EXX, UPD75PXXX, HD637XXX...).
- Covers DIP, PLCC, QFP, SOP, and PGA with 8 to 84 pins. Gang Programming adapters available also.
- EPROM EMULATION capability.
- Tests digital ICs and DRAMs (SIMM/SIP adapter available).
- Free software updates and new device added upon request.
- IC Manufacturers' approval.
- 1-year warranty, 30-day money-back guarantee.

CALL TODAY FOR MORE INFORMATION.
Distributors are welcome!



Supports: 68HCXXX MAX; PIC16XXX
DSP; PSD3XX; MACH.



Tribal Microsystems Inc.

44388 S. GRIMMER BLVD., FREMONT, CA 94538

Tel (510) 623-8859

FAX (510) 623-9925

Circle 324 on Inquiry Card (RESELLERS: 325).

SUPERPRO®
now \$599 (US only)

Over 2,000 devices, desktop programmer for your IBM PC with high speed & reliability

- Easy to use menu driven Software.
- Universal programming for E(E)PROM, Flash E(E)PROM, Bipolar PROM, PAL, FPL, PEEL, GAL, E(E)PLD, & Microcontroller, etc.
- Test TTL/CMOS logic ICs, & memory (DRAM/VRAM).
- Life time free Software updates on BBS & technical support.
- 1 year Hardware warranty & 30 day money back guarantee.
- Developed & made in U.S.A.
- Call for demo disk.

Distributors are welcome!!



E(E)PROM programmer to 4-Mbit
● ROM MASTER: \$149
● E(E)PROM programmer 4 gang version
● ROM MASTER/4: \$239
757 N. Pastoria Avenue, Sunnyvale, CA 94086
(408) 524-1929
FAX (408) 245-7084 BBS (408) 245-7082

XELTEK

Circle 329 on Inquiry Card.

Instant Microcontroller + Instant C = Instant New Product

Use our Little Giant™ and Tiny Giant™ miniature microprocessor-based computers to instantly computerize your product. Our miniature controllers feature built-in power supplies, digital I/O, serial I/O (RS232 / RS485), A/D converters (to 20 bits), solenoid drivers, time of day clock, battery backed memory, watchdog, field wiring connectors, and more! Designed to be easily integrated with your hardware and software. Priced from \$159. Core modules as low as \$59. Low cost, interactive Dynamic C™ makes serious software development easy.



Z-World Engineering

1724 Picasso Ave., Davis, CA 95616 USA **(916) 757-3737**

Fax: (916) 753-5141 Automatic Fax: (916) 753-0618

(For automatic fax call from your fax, request catalog #18)

Circle 330 on Inquiry Card.

9 Track/3480 Tape Subsystems
1/4" DAT 8mm Optical
New Windows Software Available

- Best Quality
- Lowest Prices

800/1600/3200/6250 BPI

CALL 1-800-859-8856



Laguna Data Systems

23151 Alcalde Drive, Suite B-3, Laguna Hills, CA 92653

Tel: 714-586-3010, Fax: 714-586-5538



Circle 311 on Inquiry Card.

FOR ALL YOUR TAPE NEEDS

3480 ■ 9-Track ■ 1/4" ■ 4mm ■ 8mm



**Tape to Tape Copy
Tape Backup/Restore
Conversion
Data Interchange**

NovaStor Corp.30961 Agoura Rd., Suite 109
Westlake Village, CA 91361**Phone (602) 396-3616**

or 818-707-9900 • Fax: 818-707-9902

Circle 336 on Inquiry Card.

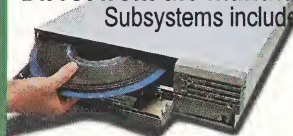
9-Track for PCs

Mainframe to PC data interchange

Rock solid solutions, rock bottom prices.

Direct from the manufacturer. 1600 & 6250 bpi.

Subsystems include drives and software.

**800-729-8725****OVERLAND DATA®**

Since 1980

PC EXPO: #756

COMDEX: #S630

Tel: 619-571-5555 • FAX: 619-571-0982
Europe: Tel: (+49) 6172-35027 • FAX: (+49) 6172-35028**Ask about 3480 tape drives too**

Circle 315 on Inquiry Card.

Desktop 9-Track Tape Subsystem

#1-selling 9-track system on desktop.



Qualstar's low cost 1/2-inch 9-track Streaming tape systems bring full ANSI data interchange to IBM AT, PS/2 or Macintosh, giving your micro the freedom to exchange data files with nearly any mainframe or minicomputer in the world.

Systems include DOS or Xenix compatible software, coupler card and cables. High reliability 1600 or 6250 BPI capability may be used for disk backup as well as data interchange.

QUALSTAR®

9621 Irondale Ave., Chatsworth CA 91311

©1989 Qualstar Corp.

All product and company names and trademarks are the exclusive property of their respective owners.

**Call us today! For details and
to order: Fax (818) 882-4081
Phone (818) 882-5822**

Circle 318 on Inquiry Card.

FAX = SCANNER

Enables your Fax machine to become a scanner!

Software & Hardware

****Features****

- Word-processor compatible
- Mouse compatible
- User friendly
- Phone book for easy fax dialing
- Edit graphics, images, photos and text
- Include all tools for a laser quality fax
- Folders for filing faxes and name cards
- Full page scanning

FX SCAN ONLY \$79.95

**Available for IBM compatibles
TO ORDER: 1-800-949-1292**

Questions call: 1-714-468-5555

Apple Version Coming Soon!



Circle 358 on Inquiry Card.

PC BOARD SOFTWARE

Great Features • Great Value • Great Price

**EAGLE 2.6**

Schematic • PCB Layout Editor • Autorouter

**Over 8000 copies sold worldwide!**

• EAGLE is a high value, low priced program. With the first layout you will see an immediate return on your investment.

• EAGLE is very easy to use and to understand.

• Unlike many other PCB programs, EAGLE has virtually no limitations. Design any board on your AT compatible computer which can be manufactured.

• EAGLE's Autorouter and Schematic Modules are fully integrated with the Layout Editor.

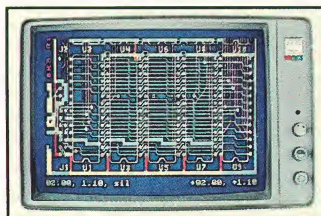
Full SMD and Multilayer support, up to 255 layers. Libraries and Drivers included.

Find out for yourself. Call for 100% working demo which includes original manual.

EAGLE Demo \$ 12**EAGLE Layout Editor \$ 399****Schematic Module \$ 399****Autorouter Module \$ 399****To order call toll-free 1-800-858-8355**

**CadSoft Computer, Inc. • 801 S. Federal Highway
Delray Beach, FL 33483 • Fax (407) 274-8218**

Circle 341 on Inquiry Card.

**smARTWORK® PCB Software**

Wintek Corporation
1801 South Street
Lafayette, IN 47904

(800) 742-6809

The first printed-circuit-board program for the IBM PC, and still the first choice for designers of 2-sided PCBs, occasional users, and educators. The program's features include unmatched ease of use, continual design-rule checking, automatic pad shaving, trace filleting, soldermasks, and silkscreen. smARTWORK with autorouting is \$895 (\$495 without) and has a 30-day money-back guarantee. Call (800) 742-6809 or (317) 448-1903.

Circle 328 on Inquiry Card.

EM320**WINDOWS****DEC VT320 Emulation for Microsoft Windows 3.X**

- 132 column display
- Cut and paste
- Kermit file transfer
- Windows style help
- Local or ANSI color
- Multiple instances
- Automatic window sizing
- Double high/wide characters
- LAT, INT 14 or TCP/IP support
- Modem dialer/Phone book
- Command language
- International character sets

Diversified Computer Systems, Inc. (303) 447-9251

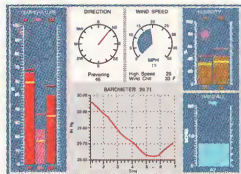
FAX (303) 447-1406 Other products: EM320 DOS, Tektronix 4105 DOS

Circle 388 on Inquiry Card.

Data Acquisition

WEATHERLINK

The Ultimate In Weather Monitoring!



- Create daily, weekly, monthly, yearly plots
- Compare two weather conditions on the same graph
- Plot two days, weeks, months, or years on the same graph
- Store data for up to 4 months before transferring to the PC
- Monitor conditions at remote locations using a modem

The ultimate in weather monitoring systems, Weatherlink works with any of Davis' weather stations to bring the weather to your PC!

• IBM compatible, 640K RAM required • Hercules, CGA, EGA, and VGA

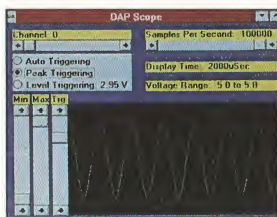
Call Today: 1-800-678-3669 M-F 7 a.m. to 5:30 p.m. Pacific Time
30-day money-back guarantee • M/C and VISA • FAX 1-510-670-0589 • BY823U

DAVIS INSTRUMENTS 3465 DIABLO AVE., HAYWARD, CA 94545

Circle 339 on Inquiry Card.

INTELLIGENT DATA ACQUISITION

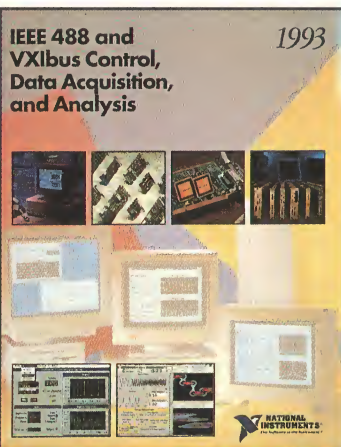
Now you can run high speed data acquisition under Windows™. A Data Acquisition Processor™ with on-board intelligence handles the critical part of an application: the tasks that run in real time. The DAP can be controlled from any Windows language or application that can make DLL calls. The one shown here is written in Visual Basic™ and uses only seven DLL functions.



**MICROSTAR
LABORATORIES™**

Phone: (206) 453-2345
or fax: (206) 453-3199

Circle 313 on Inquiry Card.



Data Acquisition and Instrument Control

Free 1993 catalog of measurement and instrumentation products for PCs, workstations, and more. Features new LabVIEW software for Windows and Sun, and LabWindows. Describes IEEE 488.2 interfaces, plug-in data acquisition boards, VXIbus controllers, DSP hardware and software, and signal conditioning accessories. Training classes also detailed. Includes tutorials and glossary.

National Instruments

6504 Bridge Point Parkway, Austin, TX 78730
(512) 794-0100
(800) 433-3488 (U.S. and Canada)
Fax (512) 794-8411

Circle 314 on Inquiry Card

Database • Education • Engineering/Scientific

dBASE Data Entry



The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT/PS-2 systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via sealed touch keys or an optional barcode scanner or badge reader (Code39, UPC+). A multi-terminal network controller (up to 250 stations) and a dBASE IV compatible software package are also available. System costs start below \$300 per station. Options include display backlighting, barcode scanning, counter inputs, control output.

COMPUTERWISE®

302 N. Winchester • Olathe, KS 66062

913-829-0600 • 800-255-3739 • FAX 913-829-0810

Circle 297 on Inquiry Card.

EARN YOUR COLLEGE DEGREE AT HOME

B.S. & M.S.
In Computer Science

Get the opportunity and earning power a college degree confers—without leaving home and without spending thousands of dollars.

- Approved for tuition reimbursement by leading corporations
- ALL COURSES BY CORRESPONDENCE
- Most courses interactive
- Approved Ada course available
- Qualified instructors available on telephone help lines

Phone: 1-205-323-6191 • FAX: 1-205-328-2229
2101 BYX Magnolia Ave. • Suite 200 • B'ham, AL 35205

**AMERICAN
INSTITUTE
FOR
COMPUTER
SCIENCES**

The leading edge of learning

ROMboy

Low Cost, Reliable, High
Quality ROM Emulation from
the Creators of PROMICE



- Emulation of up to 1 Mbit ROMs (4 Mbit - soon)
- Supports any ROM type (DIP or PLCC)
- Supports high speed ROMs
- Supports any word size up to 2048 bits wide
- Host software for DOS, Unix, Mac, VMS
- Battery backed memory
- Intelligent micro-controller based unit
- SMT CMOS layout for robustness
- Tiny size: 2.5" x 3.8" x 0.9"
- Unbelievably low price! \$295

ROMboy...

from the authority in firmware development tools

Orders: (614) 899-7878
West: (415) 750-0219
FAX: (614) 899-7888

**Grammer
Engine
Inc.**

Circle 340 on Inquiry Card

FINALLY, SERIOUS PC HARDWARE DIAGNOSTICS!

New for '92
V-ATE PLUS
Now Supports
XT, AT & EISA

STOP SCRAPPING
FAULTY MOTHERBOARDS

If you've been disappointed with traditional diagnostics and "Passive Post Cards," or are looking for an alternative to high cost ATE Systems - Put V-ATE plus to the test! We're certain you'll find V-ATE the best investment you've made in years.

- Find Failures in 100% DEAD Systems
- Find Intermittent Faults
- Test for PC Compatibility and reject Sub-standard or Faulty hardware
- Tests 88/286/386/486 PCs



VISTA MICROSYSTEMS, Inc.

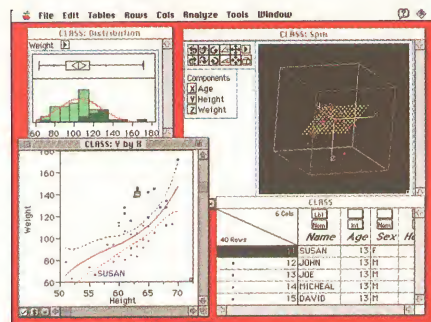
6 Whipple St., No. Attleboro, MA 02760
Tel. 508-695-8459 • FAX 508-695-8688

Circle 327 on Inquiry Card.

Make this your "leap" year with **JMP® Statistical Discovery Software**

"JMP,
from the
SAS
Institute,
is the most
surprising
Mac
product in
years...with
the most
helpful

Mac interface of all the statistics programs
and one of the best interfaces ever produced
for scientific software. It's nothing less than
dazzling."



MACWORLD

Call today for a free demo disk and Points
of Interest from the leading name in data
analysis software...SAS Institute Inc.
919-677-8000. Fax 919-677-8166.

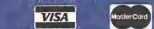
JMP is a registered trademark of SAS Institute Inc.
Copyright © 1992



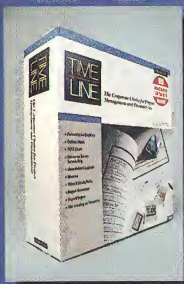
Circle 319 on Inquiry Card.

1-800-753-7877

International Orders Call (503) 386-1375



**SURPLUS
SOFTWARE
INTERNATIONAL**



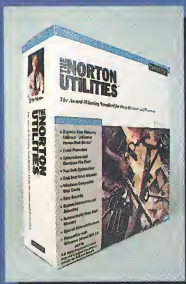
Only \$99 • TIME LINE 4.0

- Outline Gantt - PERT chart - Scheduling - Macros - Report Generator - What if's?
- The Corporate Choice for Project Management and Presentations!
- Saves Time and Money!
- Retail \$699!

Only \$59

NORTON UTILITIES 6.0

- Recovers Your Valuable Data!
- Guards Your Data!
- Speeds Up Your Hard Disk!
- The Ultimate DOS Enhancer!
- Windows 3.1 Compatible!
- Retail for \$149!



Only \$39

PFS First Publisher 3.0

- Create professional publications!
- Rotate words and graphics, resize and modify any image!
- Wrap text around graphics!
- Import from your word processor.
- Includes 150 clip art images
- Includes 60 Fonts. 3 1/2" Disks
- Retail for \$149!



Circle 356 on Inquiry Card.

Windows, OS/2, DOS Communications

Powerful C++ class library for
asynchronous communications

Greenleaf Comm++

- Interrupt driven communications
- Supports Zortech, Microsoft, JPI and Borland C++.
- IBM PC and compatibles.
- COM1..8 (DOS), and DigiBoard.
- Baud rates to 115,200.
- XON/XOFF, RTS/CTS controls.
- XMODEM, Kermit file transfers.
- VT52, VT100, ANSI & TTY emulations for DOS.
- Hayes modem control classes.
- Line and link level controls & status.

Greenleaf Comm++ \$199

☎ Call today for information, demo, or to order. MasterCard, VISA, AmEx, approved purchase orders.

1-800-523-9830

214-248-2561

FAX 214-248-7830

Greenleaf Software, Inc.

16479 Dallas Parkway, Ste 570
Dallas, TX 75248

- FREE unshrouded source
- FREE unlimited support
- No royalties
- Money-back guarantee



Circle 303 on Inquiry Card.

BASIC Compiler 8051/52 & Derivatives**BXC Version 4.0 New Release!**

- 100% BASIC-52 compatible & in line assembly
- Full floating point, integer, byte and bit variables
- Compatible with any RAM or ROM memory mapping
- Compile BXC program into CALLable subroutine
- Compile program to coexist with BASIC-52 interpreter
- DS/5000 chip support and extensions
- Dynamic length variables and many string functions
- Advanced run-time error trapping & buffered serial I/O

BXC51 \$295**Call now! 508-369-9556 or FAX 508-369-9549****Binary Technology, Inc.**

P.O. Box 541 • Carlisle, MA 01741

**APL**

Complete APL system \$60. PC, 386, WINDOWS.

J

Ken's new APL for teaching and research. Uses ASCII. Shareware and documentation \$24. Source \$90.

Iverson Software Inc.

33 Major St., Toronto, Ontario, Canada M5S 2K9

Phone (416) 925-6096 Fax (416) 488-7559

Circle 346 on Inquiry Card.

Cross Assemblers, Simulators, Disassemblers**Processor Families:**

8051	8096	8048
Z80	64180	6301
6805	6800	1802
6811	6502	68k
8085	6801	Z8

Join Thousands of Satisfied Customers Worldwide.

Call:

PseudoCorp

716 Thimble Shoals Blvd., Newport News, VA 23606

Tel: (804) 873-1947 • Fax: (804) 873-2154

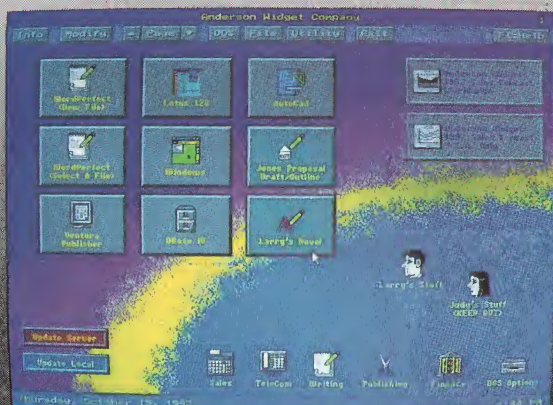
Circle 317 on Inquiry Card.

Call 1-800-793-7356**For your multimedia sound editing needs****Only \$99**

Requires Windows 3.1 and compatible sound board.

Order the full-working demo with a CD of nearly 100 professional sound clips from The Hollywood Edge for only \$5 plus S&H.
 Digital Soup, Inc. • PO Box 1340 • Brattleboro • Vermont 05302

Circle 358 on Inquiry Card.

Setting The Standard in Graphical Menuing Systems!**QuikMenu™ III**

Demo Disk Available
 OEM & Dealer Inquiries Welcome
 References Available

Features: Free Form Screen Layout, Choice of Fonts & Colors, Automatic Installation, File Manager, Icon Editor, Calculator, Calendar, Phone Dialer, Usage Tracking, Password Protection, User Prompting, NOT Memory Resident, PCX Background (req. EMS), Network Compatible, Supports CGA/EGA/VGA/Hercules, Does NOT Require Windows!

\$89.95*

30 day money back guarantee!

1-800-545-1392

*Plus shipping & handling



OSCS
 Software
 Development
 Inc.



354 NE GREENWOOD AVENUE, SUITE 108 ▲ BEND, OREGON 97701
 VOICE: (503) 389-5489 ▲ FAX: (503) 388-8221 ▲ BBS: (503) 383-7195

Circle 334 on Inquiry Card.

Breaking The Foreign Language Barriers!**Globalink Translation Software...**

incredibly accurate
 foreign language translations
 at record speeds.

• Works with Word Perfect! •

Up to 100 times faster than human translators, with an accuracy rate often exceeding 90%, *Globalink Translation Software (GTS)* makes quick work of foreign language translations. Sentence by sentence — not word by word — in correct grammatical structure, *GTS* translates entire documents to and from English and **Russian, German, French, Spanish**. From only \$495, *GTS* is on the job in thousands of companies worldwide. Call Globalink now. And break through your own foreign language barriers!

See your software dealer or call Globalink today!**1-800-255-5660**

(1-703-273-5600 Outside The U.S.)

Circle 301 on Inquiry Card.

THE BUYER'S MART

A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER'S MART is a monthly advertising section which enables readers to locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes an Inquiry number to assist interested readers in requesting information from participating advertisers.

Effective January 1, 1992.

RATES: 3 issues—\$625 6 issues—\$600 12 issues—\$525 13 issues—\$500

Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must

furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated) plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Margot Gnade at 603-924-2656. FAX: 603-924-2683.

ACADEMIC COMPUTING

LEARN PARALLEL PROCESSING Transputer Education Kit \$396

Kit includes ready-to-use PC add-in board with T400 transputer, 1MB of RAM, and PC interface. Complete with Occam2 and C compilers, assembler, source-level debuggers, example programs and 1500 pages of documentation (incl. schematics). Expandable!

Computer System Architects

100 Library Plaza, 15 North 100 East, Provo UT 84606-3100
(800) 753-4CSA (801) 374-2300 FAX (801) 374-2305

Inquiry 701.

ACCESSORIES

RADIOACTIVE?

Plot it on your PC with The RM-60 RADIATION MONITOR. Serial or printer port. Detects: ALPHA • BETA • GAMMA • X-RAY. MicroR, 1000 times the resolution of standard geiger counters. Excellent for tracking RADON GAS. Find sources. New: Version 2.9 + WINDOWS, Plot: • Background • Cosmic Rays • Clouds • Foods. Call/Write for PC MAGAZINE review. • TSR • GM Tube VISA/MC/EURO Phone orders. Not satisfied? Full refund.

800-729-5397 or Tel/Fax: (302) 655-3800

Aware Electronics Corp.

P.O. Box 4299, Wilmington, DE 19807 \$149.50

CUT RIBBON COSTS

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one ink! For crisp, black professional print since 1982. You can choose from 3 models:

Manual E-Zee Inker—\$39.50

Electric E-Zee Inker—\$94.50

Ink Master (Electric)—\$199.00

1000s of satisfied users. Money-back guarantee.

BORG INDUSTRIES

525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404 In IA: 319-987-2976

Inquiry 702.

KEYBOARD, VIDEO, MOUSE, AUDIO

Extend signals from PC with **EXTENDER**. Split signals with **COMPANION/PC EXPANDER**. Switch signals among PCs with **COMMANDER**.

Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard, monitor and mouse.

CYBEX CORPORATION

2800H Bob Wallace Ave., Huntsville, AL 35805
Phone: 205-534-0011 Fax: 205-534-0010

Inquiry 703.

TAKING PC OVERSEAS? We've Got 220V/115V Converters All Wattages

Your Converter & Cable Connection Source!

Cables • Books • Computer Batteries

No. California's Largest "In-Stock" Computer Supplies & Parts Inventory

(800) 321-4524 (CA)

(800) 548-7135 (US/Can)

ELECTRONICS PLUS inc.

Inquiry 704.

ACCESSORIES

CUSTOM KEYBOARDS AND TERMINALS Engineering, Development and Production

- Point-of-Sale • Special purpose • Harsh environment
- Access control • Data collection • Operator input
- Unique • Industrial • Any interface, key style or size
- No minimum quantity required

GENOVATION, Inc.

17741 Mitchell North, Irvine, CA 92714
(800) 822-4333 (714) 833-3355 FAX (714) 833-0322

Inquiry 705.

ARTIFICIAL INTELLIGENCE

FUZZY LOGIC AND NEURAL NETWORK TRAINING AND DEVELOPMENT SYSTEMS

PC-based add-in cards with menu-driven software and instruction manual. Allows user to learn Fuzzy Logic and Neural Networks in addition to developing actual applications. Pricing from \$395.00

AMERICAN NEURALOGIX, INC.

411 Central Park Drive, Sanford, FL 32771
Phone: 407-322-5608 Fax: 407-322-5609

Inquiry 706.

BAR CODE

LABELING SOFTWARE

On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 18 text sizes to 3"-readable at 100'. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—\$279. Other programs from \$49. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

BAR CODE READERS

For PC, XT, AT, & PS/2, Macintosh, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—\$399. Top rated in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

PORTABLE READER

Battery-operated, handheld reader with 64K static RAM, 2x16 LCD display, 32-key keyboard, Real-Time-Clock. Wand or laser scanner. Program prompts and data checking through its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

BAR CODE

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM

Add bar codes and big graphics characters to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39, Epson, OKI, IBM dot matrix text up to 1/2". LaserJet up to 2". Font cartridges not required. \$179-\$239. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

BAR CODE READERS

Keyboard emulation for PC/XT/AT & PS/2s, all clones and any RS-232 Terminal. Transparent to your operating system. Available with Steel wands, Lasers, Slot & Magstripe Readers. Same day shipping. 30-day money-back guarantee. One-year warranty. Reseller discounts available.

AMERICAN MICROSYSTEMS

2190 A Regal Parkway, Eufless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

PORTABLE BAR CODE READER

Battery operated, handheld reader with 64K RAM, 54 key keyboard, real-time clock, 2X16 LCD display, and built-in calculator. Supports WAND, COD, and LASER. Built-in program generator supports multiple programs and data files. Interfaces to PC & PS/2 keyboards, RS-232 terminals, and HAYES compatible modems. 30-DAY MONEY-BACK GUARANTEE.

AMERICAN MICROSYSTEMS

2190 A Regal Parkway, Eufless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BAR CODE PRINTING SOFTWARE

- MS/PC DOS Systems • Import/Export ASCII files • 9 & 24 pin dot matrix • H-P LaserJet/Plus/Series II
- Menu-driven or Memory Resident • Most Label Sizes • Multiple Densities • Variable Graphic Heights • Code 39, 1/2/5, UPC A/E, EAN 8/13, 128, 93, 11, MSI/PLESSEY, POSTNET (ZIP+4).

AMERICAN MICROSYSTEMS

2190 A Regal Parkway, Eufless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

ULTIMATE BAR CODING

- KEYBOARD WEDGES for PC/XT/AT, PS/2 with wand, \$249. RS232 & IBM terminals. Mac, AT&T, NEC, Wang...
- PORTABLE readers 64K-256K, \$750
- HP wands/PCS, SP lasers/CODs/mag stripe & badge slot
- Software to print & read bar codes
- P.O.S. — cash drawers/receipt printers...
- 30-day \$\$ back / 1 Year Warranty.
- Generous Dealer Discounts — Se Habla Español!

BARCODE INTERNATIONAL SYSTEMS

9190 Palm Canyon Dr., Corona, CA 91719
(714) 277-1917 FAX: (714) 277-1005

Inquiry 707.

THE BUYER'S MART

BAR CODE

READ BAR CODES!

The Standard Edition of KNOW-WEDGE for CODE 39 Complete with Hewlett-Packard Wand.

ONLY \$149.00.

For alternative hardware or software solutions

CALL

COMPUTER RESOURCES GROUP

629 Silverdale Drive, Claremont, CA 91711

VOICE: (714) 624-8734

BBS: (714) 626-1054

Inquiry 708.

I. T. S. Bar Code Solutions

Bar codes are easy using our FULL line of readers & printers. They plug and play with your existing CPU/printer/terminals/ software systems in your office, store, truck, factory or warehouse. ITS' bar code DOS programs print on matrix or laser printers. 30 day refund. 1 year warranty. OEM/VAR/ Dealer discounts.

International Technologies & Systems Corp.

655-K North Berry St., Brea, CA 92621 - Western USA

13 Welwyn Court, Richmond, VA 23229 - Eastern USA

(800) 228-9487 (714) 990-1880 (804) 741-6725 (FAX) 990-2503

Inquiry 709.

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost-effective data entry. They emulate your keyboard, so data looks just like it was typed in! Choose from stainless steel wand, laser gun, card slot or magnetic stripe scanners. Also, powerful label printing software. Great warranty. Generous reseller discounts. 30-DAY MONEY-BACK GUARANTEE.

Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052

1-800-758-2001

206-451-8966

DATA INPUT DEVICES

Bar Code, Magnetic Stripe Readers & SmartCard Encoder/Reader for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics

4047 Transport, Palo Alto, CA 94303

415-856-6833 Telex 371-9097 TPS PLA

1-800-526-5920 FAX: 415-856-3843

Inquiry 710.

VARIANT MICROSYSTEMS

BAR CODE READERS DELIVER

- WAND/LASER/MAGNETIC CARD CONNECTIVITY
- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2, and portables
- RS232 wedges for WYSE, Link, Kimtron terminals
- Bar code and label printing software
- Full two-year warranty
- 30-Day Money-Back Guarantee
- Extensive VAR/Dealer Discounts

46560 Fremont Blvd., Suite 206/Fremont, CA 94538/(510) 440-2870
800-666-4BAR FAX: (510) 623-1372

Inquiry 711.

BOOKS/TECHNICAL

Here is your QUE

to great savings on new computer books

- Newest releases
 - Fast UPS delivery
 - All major publishers
 - Free Catalog-on-a-Disk
- Ziff-Davis-McGraw Hill-Microsoft Press-Que-New Riders Press
SAMS-Brady-Sybase-Addison Wesley-Ventura
Peach Pit Press-Bantam-Wiley-Van Nostrand-W.H. Freeman

Discounts: 1 Book 25% OFF 3+ Books 30% OFF

Visa, MasterCard and Discover Card Accepted

README.DOC COMPUTER BOOKS

211 N. Second Street, Chambersburg, PA 17201

(800) 678-1473

Fax: (717) 264-8614

Inquiry 712.

360 B Y T E • NOVEMBER 1992

CABLES AND ACCESSORIES

SPECIAL-PARALLEL-PRINTERCABLES

for PC's and similar systems

10 FT	US\$	77
100 FT	US\$	282
300 FT	US\$	708

All intermediate lengths available on request. Dealers are welcome. Delivery! FOB Munich, C.O.D.

HOLLER EDV PEREPHERIE GMBH

Boehmerwaldstr. 8A, D-8192 Geretsried, W-Germany

Tel. 08171/31702

Fax. 08171/81275

Inquiry 713.

CAD

PCB & SCHEMATIC CAD-\$195

"EASY-PC" for single-sided and multilayer boards to 17"x17" with up to 1500 ICs including surface mount. Phenomenally fast and easy to use. Over 13,000 copies sold. Needs PC/XT/286/386 HERC/CGA/EGA/VGA. Output to laserjet/inkjet/dot matrix printer, pen-plotter, photo-plotter and NC Drill. Not copy protected. VISA/MC/AMEX welcome. For full info circle inquiry # or contact us directly.

NUMBER ONE SYSTEMS LTD.

Harding Way, St. Ives, Huntingdon, Cambs, England, PE17 4WR

Tel: 011-44-480-61778 Fax: 011-44-480-49042

Inquiry 714.

Sirlin's CAD ++ ENGINE

- Read and Write AutoCAD DWG and DXF files.
- Object oriented, modular, database-like access to CAD data.
- View, Print (rasterize), Plot (vectorize), and Pick (interact) modules.
- Available for C/C++ for DOS, Extended DOS, Windows, Sun and other Unix systems.

Sirlin Computer Corporation

25 Orchard View Dr., Ste 14, Londonderry, NH 03053

Phone: (603) 437-0727 Fax: (603) 437-0737

Inquiry 715.

CAD/CAM

CONTOURING MOTION CONTROL

FROM A PRINTER PORT!

NEW

Indexer LPT™ software

VERSION 3

- Controls up to six step motors simultaneously.
- Linear and Circular Interpolation.
- New features to accommodate machine control.
- Easy-to-use DOS device driver. Super Manual.
- CAD-CAM interface available.

Ability Systems

\$249 VISA/MC

Corporation, 1422 Arnold Ave.

Roslyn, PA 19001 (215) 657-4338

FAX: 215-657-7815

Inquiry 716.

Desktop Prototyping Printed Circuit Boards

Now, with our kit and a desktop plotter, you can make single and double sided printed circuit boards IN MINUTES. Fine pitch lines with throughpad routing plotted directly on rigid board! Our product includes a complete tutorial package with demonstration CAD files on disk. For more information on kit, plotters, and/or accessories write:

Tri State Technical

P.O. Box 350, Westbrookville, NY 12785

Fax: 914-888-0531

Inquiry 717.

CD-ROM

High Performance Self Contained

Portable CD-ROM Computing

Uncompromising Portable CD-ROM Computer Systems

4-64 MB RAM / 120-540MB HDD / Internal CD-ROM

FCC Class B Certified

386DX-33 - \$3495 / 486DX-33 - \$3995

ACCESS INFORMATION INC.

The information retrieval experts

1-800-847-3830

Inquiry 718.

CD-ROM

CD-ROM DRIVE & 10 FREE DISCS

High Performance CD-ROM drive:

DOS/MPC: Encyclopedia, Atlas, Mammals, Shareware, Danger Hot Stuff, Games II, Wild Places, World View, Crossword Cracker, Demonstration Disc. \$499.00 (Plus Freight)

Free Catalog (Overseas send \$5.00)

Hundreds of discs and optical products.

CD ROM, Inc.

1667 Cole Blvd., #400, Golden, CO 80401

Orders: 800-821-5245

Questions: 303-231-9373 Fax: 303-231-9581

Inquiry 719.

* Simitl MSDOS CD-ROM: Find what you need, when you need it. 550+ meg in 8300 files have the best utilities, applications, editors, programming tools, source code, etc. Thoroughly indexed. BBS ready. Produced June 92. \$24.95

* Unix/MSDOS Source CD-ROM: Stop reinventing the wheel. 600+ meg of source code, internet comp. sources. * Simitl Unix-C, lots of MSDOS source. Thousands of complete working programs in C, Asm, Pascal, etc. March 1992. \$39.95

* ISO9660, fully guaranteed. Visa/MC/COD \$&H \$5, \$10 air overseas.

WALNUT CREEK CDROM

1547 Palos Verdes Suite 260 Walnut Creek CA 94596

1 800 786 9907 +1 500 947 5996 +1 500 947 1644 (fax)

Inquiry 720.

MORE FONTS MEAN MORE FUN!

Font Fun House on CD-ROM for the IBM and the Macintosh. Hundreds of completely useable fonts for your computer. This disc contains shareware and freeware fonts in TrueType and TypeOne Postscript (ATMS) formats and also includes the Macintosh screen font libraries of both Adobe and AGFA. Over 1/3 of the fonts on this CD-ROM are FREEWARE! Suggested retail is \$49.00-order now for only \$39.00! Orders within U.S., add \$3.00 for UPS shipping and orders outside U.S., add \$8.00 for airmail delivery. Minnesota residents add 6.5% sales tax.

Wayzata Technology Inc.

Post Office Box 807, Grand Rapids, Minnesota 55744

Tel: 800-735-7321 (218) 326-0597 Fax: (218) 326-0598

Inquiry 721.

COMMUNICATIONS

3780 • BSC • RJE

- UNIX, OS/2, MS-DOS, and Windows
- Single and Multi-channel options
- Script, API, & Menu-Driven Interfaces
- Unattended and Interactive sessions
- Ideal for VARs, OEMs, and end-users!

Serengeti Systems Incorporated

Call (800) 634-3122 or FAX (512) 480-8729

Inquiry 722.

X.25, HDLC, SDLC, BSC

SDLA card and software provides 'plug-in' synchronous link support for PCs which is inexpensive, easy to use and robust. Coprocessor architecture ensures reliable communications under any operating system at line speeds to 180kbps. Packages include protocol analyser, test and development software. OEM enquiries welcome.

Full function SNA emulation packages also available.

Sangoma Technologies Inc.

(416) 474-1990 1-800-388-2475

Inquiry 722.

COMPUTER BOOKS

COMPUTER BOOKS at a discount

15% discount. Latest books, 50 publishers.

Free catalog. UPS & international shipping.

Personal service. MC/Visa.

CompuServe 70007.1333. GO CBK

From Internet: 70007.1333@compuserve.com

Windows, C++, O/S 2.0, UNIX, Mac, OOP

CompuBooks

Rt. 1, Box 271-D, Cedar Creek, TX 78612 USA

800-880-6818, 512-321-9652 voice & FAX

Inquiry 723.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFWARE Computerowner's coverage provides replacement of hardware, media and purchased software. As little as \$49 a year covers accidents, theft, power surges and more. One call does it all.

TOLL FREE 1-800-848-3469

SAFWARE, The Insurance Agency Inc.

PO Box 02211, 2929 N. High St., Columbus, OH 43202

Inquiry 724.

COMPUTER SYSTEMS

LOW-LOW-LOW

Computer Systems/Notebooks/Network Solutions
IBM-Apple-Compaq-AST-ALR-Everex-&others
SURAH 386/486 ISA/EISA-AMI/Mylex Motherboards
• CD ROMS • Tape Backup • Pocket FAX Modem LAN
Cards • Hard Drives/Floppy Drives • Memory/upgrades
• DRAMS, SIMM Modules • Laser Printers/Scanners
• Plotters & Digitizers • Software

44912 Osipow Road, Fremont CA 94539 USA
Phone: (510) 651-5101 Fax: (510) 651-5241

SURAH inc.

1-800-543-1001 Nationwide Orders

Inquiry 725.

COPROCESSORS

MATH ACCELERATOR - \$25

Near-coprocessor performance from software!

• Up to 6X faster spreadsheets, graphics, CAD, fonts generation, etc. • DOS, Windows, EMM, & DOS Extenders compatible. • Uses NO DOS memory! • For 386SX and higher processors. • Full coprocessor emulation, application transparent.

Get Q387 Ver. 3.0 from CompuServe (IBM hardware forum), America OnLine, Genie, Delphi, etc., or call:

QuickWare
(512) 280-1452

Inquiry 726.

CROSS ASSEMBLERS

CROSS ASSEMBLERS

Fast, reliable with unlimited length of source code. Conditional assembly, complete set of arithmetic and logical operators. Optional listing with sorted Cross-reference Table. Price \$100.00 each.

SIMULATOR-DEBUGGERS/DISASSEMBLERS
We offer excellent full-function simulators with built-in disassemblers for the 8048/49, 8051/52, 8080/85, and Z80 controllers, and now for the 8096 and 80C196, with their unique features fully supported. Prices from \$200 to \$300 each, with \$50.00 discounts for XASM + SIM packages.

Lear Com Company

2440 Kipling St., Ste. 206, Lakewood CO 80215
(303) 232-2226 FAX (303) 232-8721

Inquiry 727.

CROSS DISASSEMBLERS

PROFESSIONAL DEVELOPMENT SOFTWARE ASSEMBLERS/DISASSEMBLERS

8051, 8048, 8096, 8080/85, Z80/180
Z8000, SPARC, 6800, 6809, 68HC11, 680X0,
6502/C02, 6301, 9900

COMPLETE, OPTIMIZED DEVELOPMENT TOOL SETS
FOR THE ENGINEERING PROFESSIONAL

CALL (408) 773-8465

LOGISOFT

PO BOX 61929, SUNNYVALE CA 94086
FAX: (408) 773-8466

Inquiry 728.

DATA CONVERSION

TAPE CONVERSION & DUPLICATION

• DC2000 • 1/4" Cartridge
• TEAC • 4mm DAT
• 8mm EXABYTE • DEC TKxx media
• 1/2" Tape • 3480 & 3490

Mainframe, Mini or Micro - popular or obscure.

Fixed price quote by return. Standard turnaround 24 Hours.
TEL 44+ (0) 734-890042 FAX: 44+ (0) 734-890040

Vogon Enterprises Ltd.

Unit 5, Forrest Court, Oaklands Park, Fishponds Road,
Wokingham, Berks., RG11 2FD, England

DATA RECOVERY

Ontrack DATA RECOVERY

- Unsurpassed success rate • Fast turn around
- Priority service available • Clean room
- Expertise in DOS, OS/2, Novell, Macintosh,
Unix, Xenix, Sun, DEC, Wang,
Banyan Vines and more!

MN:1-800-872-2599 • CA: 1-800-752-7557

6321 Bury Drive, Eden Prairie MN 55346
2400 Main Street, Suite 200, Irvine CA 92714

Inquiry 729.

TAPE DATA RECOVERY

- DC2000 • 1/4" Cartridge
- TEAC • 4mm DAT
- 8mm EXABYTE • DEC TKxx media
- 1/2" Tape • 3480 & 3490

Whatever the Hardware, Software & Problem...

if there is data on a tape we will recover it.

TEL 44+ (0) 734-890042 FAX: 44+ (0) 734-890040

Vogon Enterprises Ltd.

Unit 5, Forrest Court, Oaklands Park, Fishponds Road,
Wokingham, Berks., RG11 2FD, England

DATA/DISK CONVERSION

THE #1 CHOICE in disk & tape conversion

for many leading corporations, government agencies,
law firms, and companies in every industry-world-wide.

Free test • Satisfaction guaranteed

Graphics Unlimited Inc.

3000 Second St. North, Minneapolis, MN 55411

(612) 588-7571 FAX: (612) 588-8783

1-800-745-7571

Inquiry 730.

IBM PC TO HP FILE COPY FASTER EASIER TO USE

Update version uses windows: Call for free demo! IBM
PC <to> HP File Copy allows IBM PCs, PS/2,
compatibles to interchange files with Hewlett-Packard
Series 70, 80, 200, 300, 1000, 9000s.

Oswego Software

Box 310
Oswego, IL 60543

708/554-3567

FAX 708/554-3573

Inquiry 731.

CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over
4000 formats including 3 1/2", 5 1/4", 8" disk formats &
word processors. Disk-to-disk conversions also
available. Call for more info. Introducing OCR
Scanning Services.

Pivar Computing Services, Inc.

165 Arlington Hgts. Rd., Dept. #B

Buffalo Grove, IL 60089 **(800) Convert**

DEBUGGING TOOLS

INTRCPT Function Calls

- ★ Real-Time Monitor, Trap, Log, & Call
- ★ Automatic Function Identification
- ★ Register and Buffer Dumps at Call/Ret
- ★ Real-Time Debug and Disassemble
- ★ DOS 5.0/Windows Enhanced Mode
- ★ Easily Modify Calls in Progress

\$99.00 Ask for FAX HACKENSACK

(800) 325-4225

P.O. Box 181386
Arlington, TX 76096

Inquiry 732.

DIAGNOSTIC

"..PINPOINT ANY PC FAILURE."

John C. Dvorak, PC Magazine 7/30/92

Top-rated PocketPOST Power On Self-Test card
with diagnostic software for ISA/EISA/Micro-
Channel. 180-page book. Hones your trouble
shooting skills. CALL NOW.

DATA DEPOT, Inc.

1710 Drew Street #5, Clearwater, FL 34615

1-800-275-1913

813-446-3402

FAX 813-443-4377

Inquiry 733.

DISASSEMBLERS

80x86 .COM/.EXE/.SYS files ->.ASM!!!

Automatic!-You must enter only input/output filenames!
Easy-to-use!-Menu operation, mouse support, on-line help.
Accurate!-Exhaustive, compiler-proven **flow analysis**-
methods, **not heuristics**, distinguish code from data.

Complete!-Fully labeled 80x86 code, data and pseudo-ops.
Detects **one-byte data** items even in **instruction areas!**
Comments on BIOS/DOS/INTs show function-operand!

NEW! PC-DISDATA 4.5 (5-1/4" disk & manual) only \$165.
PRO/AM SOFTWARE
220 Cardigan Road, Dayton, OH 45459-1712
(513) 435-4480 (9 A.M.-5 P.M. EST M-F)

Inquiry 734.

DSP DEVELOPMENT

Digital Signal Processing

- TMS320C30 and TMS320C25 processor boards with up to 8Mbyte fast SRAM.
- Analog interface modules, dual channel, 16-bit resolution, up to 400KHz sample rate.
- C compilers, Assembler/Linkers, Simulators.
- Data acquisition and analysis software.
- Filter design software.

Bridgenorth Signal Processing Inc.

P.O. Box 469
Custer, WA 98240

Tel: (604) 538-0003
FAX: (604) 535-9073

Inquiry 735.

EDUCATION

B.S. & M.S. In COMPUTER SCIENCE

The American Institute for Computer Sciences offers an in-
depth correspondence program to earn your Bachelor of
Science and Master of Science degrees in Computer Science
at home. B.S. subjects covered are: MS/DOS, BASIC,
PASCAL, C, Data File Processing, Data Structures &
Operating systems. M.S. program includes subjects in
Software Engineering and Artificial Intelligence.

AMERICAN INST. for COMPUTER SCIENCES

2101-BY Magnolia Ave. South, Ste. 200, Birmingham, AL 35205

800-767-2427

205-323-6191

ENTERTAINMENT

53 EGA/VGA GAMES

Buy this super collection of best-selling
games for only \$9.95, including shipping
and handling. (Please add \$5.00 for
foreign orders.) Credit Cards Only.

SMC SOFTWARE PUBLISHERS

(619) 931-8111 ext. 511

Inquiry 736.

Go, NEMESIS, Go

Go - a Zen game. So appealing, it has endured 4,000
years. So useful governments study it.

NEMESIS Go Junior entices novices of any age.
NEMESIS Go Master Deluxe satiates the addicted.
Windows, Macintosh and DOS versions available.

Chaos Manor User's Choice Award (BYTE/1990)

Toyo, Inc. (800) 869-6469

PO Box 25460-Y, Honolulu, HI 96825-0460

(808) 396-5526 fax: (808) 396-4126

Inquiry 737.

THE BUYER'S MART

FLOW CHARTS

FLOW CHARTING 3

- FRIENDLY**
• High resolution print outs... dot matrix or laser
- FAST**
• Multi-page charts... portrait or landscape
- FLEXIBLE**
• Import/export capabilities
• 35 shapes, 10 fonts, 4 line styles

ONLY \$250

PATTON & PATTON Call for free demo disk!
Software Corporation 485 Cochran Cr., Morgan Hill, CA 95037
See our ad on page 170

Inquiry 738.

WINDOWS FLOWCHARTER \$129

RFFlow 2.0 is a professional drawing tool for flowcharts & org. charts. Requires Microsoft Windows. 100 shapes auto adjust in size, Diagonal lines and curves. Auto line routing and re-routing. Click on a shape to bring up a sub-chart. Move charts to other apps. via the Clipboard. Call for free trial disk.

RFF ELECTRONICS

1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 FAX: (303) 669-4889

HARD DRIVE REPAIR

Pre-Owned Electronics, Inc.TM

THE Independent Provider, serving the Dealer, Professional, Corporate, Government, and Educational Buyer since 1985

APPLE II® & MACINTOSH® SYSTEMS • PARTS • EXCHANGE REPAIRS

Call for a Catalog... **800-274-5343**
INT'L: 617-275-4600 • FAX: 617-275-4848
205 BURLINGTON ROAD • BEDFORD, MA 01730

Inquiry 739.

HARDWARE

Voice Mail/Fax/Modem/Multi Media 4-in-1 Fax/Modem w/MNP/V.42

**Upgradable 3486 w/POST LED
Affordable 486EISA/Slim-EISA**

Andgate 714-468-3084 Fax: 714-468-3078
See us at COMDEX/Fall '92 Booth #R8721

Inquiry 740.

HEWLETT PACKARD

Buy - Sell - Trade

LaserJet DeskJet RuggedWriter ColorPro DraftPro DraftMaster

Electrostatic Plotters
• Monochrome and Color

HP 9000 Workstations and Vectras also available.

T. E. Dasher & Associates
4117 Second Ave., S. Birmingham, AL 35222
Phone: (205) 591-4747 Fax: (205) 591-1108
(800) 638-4833

Inquiry 741.

HARDWARE/COMPUTERS

SC/FOXTM EMBEDDED COMPUTERS

PC Parallel Coprocessor Plug-In Boards: 15 MIPS avg 50 MIPS burst, using the SC32 32-bit CPU or the 16-bit Harris RTX 2000TM.
VME Master/Slave System Controller SBC: 18 MIPS avg 70 MIPS burst, uses RTX 2000 cpu, SCSI, 2 ser, 1 ptr ports, to 640K bytes.
Stand-Alone Single Board Computers: 18 MIPS avg 60 MIPS burst, 3U or 100x100mm Eurocard-size using either SC32 or RTX 2000.
Ideal for embedded real-time control, data acquisition, robotics, and signal processing. OEM software development system included.

SILICON COMPOSERS INC (415) 322-8763
208 California Avenue, Palo Alto, CA 94306

Inquiry 742.

LANs

The \$25 Network

Try the 1st truly low-cost LAN

- Connect 2 or 3 PCs, XT's, AT's
- Uses serial ports and 5-wire cable
- Runs at 115K baud
- Runs in background, totally transparent
- Share any device, any file, any time
- Needs only 14K of RAM

Skeptical? We make believers!

Information Modes

P.O. Drawer F, Denton, TX 75202
817-387-3339 Orders 800-628-7992

Inquiry 743.

LAPTOP COMPUTERS

USED COMPUTERS

IBM, COMPAQ, & MAJOR BRANDS
LARGE SELECTION

COMPUTERS from \$169 Monitors from \$49
CGA Color Monitors \$129 Color Printers \$249

TANDY NOTEBOOK Computer \$199
Also - IBM PCjr & Convertible ACCESSORIES & SERVICE •
MEMORY EXPANSIONS • PARTS • DRIVES • MONITORS • KEY-
BOARDS • CONTROLLERS & SOFTWARE HARD-TO-FIND ITEMS

FREE CATALOG

COMPUTER RESET

P.O. Box 461782, Garland, TX 75046
Phone (214) 276-8072 BBS & FAX (214) 272-7920

Inquiry 744.

LAPTOP PERIPHERALS

Auto Adapters

- 12V battery systems
 - Small package with high efficiency
 - Plugs between computer and lighter receptacle
 - \$99 to \$129
 - Designed and made in USA!
- In stock for Apple PowerBook (10-30V input), Canon BJ printer, Commodore, Everex Tempo LX, IBM, Kodak Diconix printer, Sanyo, Sharp, Toshiba, Zexos
- Custom adapters designed for OEMs. Serial interface cards for Toshiba and Sanyo.

EMPIRE ENGINEERING

California USA
tel 805/543-2816 fax 805/543-2820

Inquiry 745.

MULTIMEDIA

Distributor Wanted!!

By Philips Taiwan
GIVE A SECOND LIFE TO THE PC!!

"Philips DTV-1000 card" + IBM compatible PC + VGA monitor
= IDTV (Improved Definition TV)

The Philips DTV-1000 card can be connected with VCR, LD player, camcorder, or TV/CATV signal from antenna/cable, then easily convert the PC into a high quality television.

Any prospective distributor is welcome to contact Philips Taiwan:

Phone Number: 886 2 5097666 ext. 5236 (Taiwan)
Fax Number : 886 2 5005968 (Taiwan)

Inquiry 746.

NOTEBOOKS

SAVE! PALMTOPS * NOTEBOOKS SAVE!

TOSHIBA • EVEREX • ZENITH • AT & T • TANDON
AST • SHARP • BONDWELL • ALR • LIBREX
PANASONIC • ALTIMA • LEADING EDGE
PACKARD BELL • SAMSUNG • NEC • TI • COMPAQ

• We ALSO carry accessories and software •

Computer Options Unlimited

12 Maiden Lane, Bound Brook, NJ 08805

Advice?: 908-469-7959

For Notebooks: 1-800-424-Port For Sub-notebooks: 1-800-Palmtop
6 days Worldwide Sales

Inquiry 747.

PROGRAMMERS TOOLS

BOOST YOUR VISUAL BASIC!

- **VBIMPRESS** adds new print & display function :
Portrait/landscape, letter/US legal & Other print format,
Scroll bars and zoom effect (99\$)
- **CBASE** for DBASE's users. Adds 4 new controls : set
relation to, browse, 2 display controls & more than 50
functions adapted from DBASE to VB. (From Append
Blank to Zap). (219\$)

MC/VISA accepted

BEAULIEU
MONTREAL, CANADA

Tel (514) 278 96 77 Fax (514) 278 9676

Inquiry 748.

PROGRAMMERS TOOLS

THE EASIEST WAY TO ADD A WINDOWS STYLE PULL DOWN MENU TO A CHARACTER BASED PROGRAM IS BY USING PLAIN DESIGN'S MENU SYSTEM

Supports Mouse operations, Submenus, Accelerators, and menu hotkeys. Borland C, MSC, MIXC compilers. Full source code provided. Introductory offer price: \$39.95+\$4.00 shipping and handling. NJ residents add 6% tax.

Plain Design Inc.

51 Chesnut Ave., Suite 58, Ridgewood, NJ 07450
Tel (201) 670-3922 FAX (201) 251-9118

Inquiry 749.

C and C++ DOCUMENTATION TOOLS

- **C-CALL** (\$69) Graphic-free of caller/called hierarchy.
- **C-CMT** (\$69) Generate, insert, update comment-blocks.
- **C-METRIC** (\$59) Path complexity, lines/stmts/comments.
- **C-LIST** (\$59) List, action-diagram, reformat programs.
- **C-REF** (\$59) Local/global/parameter cross-reference.
- **C-DOC** (\$199) All 5 as 1 DOS program, <=15,000 lines.
- **Professional** (\$299) <=150,000 lines, DOS, OS/2, Windows.

SOFTWARE BLACKSMITHS INC.

6064 St. Ives Way, Mississauga, ONT, Canada L5N-4M1
Voice/Fax: (416) 858-4466 Demos/BBS: (416) 858-1916

Inquiry 750.

DON'T DEVELOP NETWORK APPLICATIONS
without **NPPC**, a powerful library sub-routine package that handles all the details of NetBIOS or IPX programming! **NPPC** supports high-level program communications at the message level for all server/client and peer-to-peer models. If you are using C or Assembler, **NPPC** allows you to write a single application that runs on BOTH IPX and NetBIOS without any modifications. **NPPC** is compatible with any true NetBIOS emulator, therefore applications written with **NPPC** will work with most LANs in the marketplace. We offer a 30 day money back guarantee.

SOFTWAREHOUSE CORPORATION

326 State Street, Los Altos, CA 94022
(415) 949-0203 FAX: (415) 949-0208

Inquiry 751.

Boost Your BASIC with ProBas!

- Adds 938 new commands to QB and PDS
- Written in assembly for speed
- Gives your programs a professional look
- Easy-to-use, money-back guarantee
- Free add-ons for BASIC, C & Visual Basic avail.

FREE DEMO DISK AND BOOKLET

TeraTech (800) 447-9120 x168

Dept 168, Suite 360, 3 Choke Cherry Rd., Rockville, MD 20850
Int'l (301) 330-6764 Fax (301) 963-0436 BBS (301) 963-7478

Inquiry 752.

PROJECT BILLING

CLIENT PROJECT

Complete project billing system; accounts for charges to over 100,000 projects. For a free demo and a limited time discount coupon, send \$10 (shipping & handling) to:

MICRO BILLING SYSTEMS, INC.

117 W. Harrison, Ste# 624M, Chicago IL 60605
Tel: (312) 939-1869 Fax: (312) 939-1351

Inquiry 753.

REPAIR SERVICES

VIDEOS

- Laser printer maint/repair for the layman (2 hrs.) \$39.95
- Dot matrix printer maint/repair for the layman (30 min.) \$39.95
- Fax machine maint/repair for the layman (30 min.) \$39.95

STOP UNNECESSARY SERVICE CALLS!

SPECIAL! BUY 2, GET ONE FREE!

All credit cards accepted. \$3.60 for S&H 1-800-537-0589

Viejo Publications, Inc.
4470-107 Sunset Blvd. Ste 600, Los Angeles, CA 90027

Inquiry 754.

SALES/MARKETING TOOLS

Sell More with SALES ALLY

Client & Prospect Management Database, Word Processor, & Notepad Autodialing, Reports, Alarms Invoicing, Sales Forecasting, Networks.

- PC Magazine Editors' Choice • PC Computing "Best Product" • Mobile Office Mag Annual Award

Call for FREE Information Packet.

SCHERRER RESOURCES, INC.

8100 Cherokee Street, Philadelphia, PA 19118
215-836-1830, \$395 (Visa/MC/Amex)

Inquiry 755.

SECURITY

FIGHT PIRACY!

★ EVERLOCK 3.0 ★

SOFTWARE COPY PROTECTION

New Option Board Safe-New Remote Registration
New CPU LOCK-CD ROM LOCK and more

★ EVERKEY HARDWARE LOCKS ★

Az-Tech Software, Inc.

Call for a FREE Demo (800) 227-0644
201 East Franklin, Richmond, MO 64085
(816) 776-2700
FAX (816) 776-8398

Inquiry 756.

THE ULTIMATE COPY PROTECTION

- Completely menu driven
- Defaults all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk & LAN Support
- Unlimited Metering, FREE Demo Disk

*Quite Simply
The Best
Ways To
Protect Your Valuable
Software Investment*

STOPVIEW™ STOPCOPY PLUS™ (800) 879-2224

BBI COMPUTER SYSTEMS, INC. (301) 871-1094

14105 Heritage Lane, Silver Spring, MD 20906

FAX: (301) 460-7545

Inquiry 757.

Cop's CopyLock II

The professional software protection with TRUE Machine Install. Option Board safe. OS/2, Networks, Windows, and Trace 1020.

LINK Computer

Int'l: +45 31232350 Fax: +45 31238448
US/CAN: 800-344-2545 FAX: 408-923-7061

BIT-LOCK® SECURITY

Piracy SURVIVAL 10 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. PARALLEL or SERIAL port-transparent security device. Complemented by economical KEY-LOCK™ and multifunctional COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac). Also, access control.

MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122
(303) 770-1917

Inquiry 758.

SHAREWARE

THE AMISH OUTLAW SHAREWARE COMPANY

★★★★★★★★★ FREE ★★★★★★★★★★
WITH EVERY ORDER YOU WILL RECEIVE A GREAT NEW GAME NOT LISTED IN OUR CATALOG ABSOLUTELY FREE

ALL DISKS HAVE EASY-TO-USE MENUS

SIMPLY TYPE "GO" TO ACCESS PROGRAMS

\$3.00 PER DISK 1-9 - \$2.50 PER DISK 10-UP

3.5" AND 5.25" DISKS SAME PRICE

(IBM PUBLIC DOMAIN AND SHAREWARE ONLY)

3705 RICHMOND AVE., STATEN ISLAND, NY 10312

1-(800) 947-4346 or (718) 317-0198 FAX 1-(718) 966-4766

Inquiry 759.

SHAREWARE

THE BEST FOR LESS!!

Latest shareware available at low, low prices on either floppies or CD ROMs. Check us first. Don't buy until you check price and quality.

Free catalog call (612) 934-4775 or write:

ROCKET SHAREWARE

P.O. Box 39326, Edina, Minnesota 55439

Inquiry 760.

SOFTWARE WANTED

Publish Your Program!

Young, enthusiastic and successful software publishing company looking for PC productivity and utility software to acquire or publish. For a confidential review of your software product, send information to Software Adv., 2210 Wilshire Blvd., #836, Santa Monica, CA 90403 or send/fax your Direct Link Card in the back of this issue. We will contact you promptly.

Inquiry 761.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVENTORY
- ACCOUNTS RECEIVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

\$99/\$198 ea. + S&H

DATAMAR SYSTEMS Cred. Card-Check-COD

8586 Miramar Place, San Diego, CA 92121

(619) 452-0044 (800) 223-9963

Inquiry 762.

SOFTWARE/BUSINESS

DATA ENTRY SOFTWARE

Full featured, heads-down data entry with two-pass verification, edit language, operator stats, much more! Designed for the PS/2®, PC, XT, AT or compatibles.

PCs from \$395 LAN version available

FREE 30 day trial

Computer Keyes Tel: 206/776/6443
21929 Makah Rd., Fax: 206/776-7210
Woodway, WA 98020 USA: 800/356-0203

SOFTWARE/DATA COMPRESSION

Double your hard disk ZIPIT™

- Continuous floppy archive of huge files.
- Automatic creation of self-extract file.
- One-step imploding of directory trees.
- Transfer huge files between PCs.
- Shareware version available on BBSs.
- Send \$49. Visa/MC/Check/MO.

DIRTRAN SYSTEMS INC.

PO BOX 1207, ROSLYN PA 19001

Phone (800) 995-2501 Fax: (215) 659-2029

Inquiry 763.

SOFTWARE/DOCUMENTATION

Automated User Manuals Faster! Easier! Better!

- Interactive Structured System Cuts Documentation Time 50% to 80%
- Graphics, Fonts, Extensive Printing Options
- Manuals Include Table of Contents, Full Index, Getting Started, Reference, Tutorials and More!
- Just \$199.95! Call 1-800-221-8275 for Free Demo!

DocMaker

Automated Documentation System

Task Software Co.

2856 Falling Tree Circle
Orlando, FL 32837
407-826-0348

SOFTWARE/ENGINEERING

LIB-SIGNALS

Portable ANSI C source code

- Vector & Matrix functions • FFT, FIR, ARMA, etc.
- Statistical functions • Algebraic functions
- Optimised DSP versions • Optional I/O lib for embedded targets
- Starts at 2000, US\$.

Intelligent Systems International
Lindestraat 9, B-3210 Linden, Belgium
Tel. (+32) 16-62 15 85
FAX (+32) 16-62 15 84

ISI

Inquiry 764.

Mixed Mode Simulation

- NEW IsSPICE 3 with Analog/Digital simulation
- Draws waveforms as the simulation runs
- PC and Macintosh Versions
- Filter Design
- Schematic Entry
- Extensive Model Libraries
- Waveform Analysis
- Full SPICE programs starting at \$95. Complete systems from \$990.

Call for your Free Demo and Information kit.

P.O. Box 710, San Pedro, CA 90733-0710
310-833-0710, FAX: 310-833-9658

intusoft

Inquiry 765.

GEOMETRY/TRIGONOMETRY CALCULATOR

Apollonius - Sketch-based geometry/ trigonometry solver. State-of-the-art variational geometry system lets you sketch your geometry or trig problem and automatically solves for distances, angles and areas. Integrated equation calculator, graphs and tables plus DDE and clipboard support. Ideal for surveyors, engineers, machine shops, students, architects, or anyone who uses trig. Runs under MS Windows 3.0 \$98

Saltire Software 1-800-659-1874

Inquiry 766.

CAE SOFTWARE

- ECA-2: Analog Circuit Simulator • AC, DC, Transient Analysis • MonteCarlo, WCA • Interactive/full nonlinear
- SAUNA: 3-D Thermal Analysis • PC Bds, heat sinks, & enclosures • All HT modes • Thermal parameters library
- ACTIVE: Switched Cap & Active Filters • Order 1-50 of 5 cascaded filters • (45) topologies • (8) Types

For FREE demo call:

Tatum Labs Inc.

1287 North Silo Ridge Drive, Ann Arbor MI 48108
(313) 663-8810

Inquiry 767.

SOFTWARE/GRAPHICS

Large Problems, Small Machines

Transforming Your Programs with Advanced Algorithms

Steve Heller

CONTENTS: Let's Get Small (and Fast): Introduction to Optimization. Hash, Cache, and Crunch: A Supermarket Price Lookup System. Strips, Bits, and Sorts: A Mailing List System. CN U Rd The Qiky?: A Data Compression Utility. Free at Last: A Customer Database Program with Variable Length Records. Mozart, No; Would You Believe Gershwin?: Index.

1992, 253 pp., \$29.95/SBN; 0-12-339090

ACADEMIC PRESS

HBJ Order Fulfillment Dept. #17915, Orlando, FL 32887
CALL TOLL FREE 1-800-321-5068 or FAX 1-800-336-7377

Inquiry 768.

TIFF, PCX, TARGA, GIF, DIB, BMP, DCX, EPS, WMF, WPG AccuSoft Image Format Library 2.0

Now includes image processing!

Import, export, convert, display, and print all 10 formats! DOS & Windows versions included in one package. No royalties. Includes several sample programs with source code. Supports all languages. Format compatibility guaranteed! G3, G4, TIFF-F, multi-page images etc. Rotate, scale, color reduction, sharpen etc. 30 day satisfaction guarantee. \$295

AccuSoft Corporation

160 E. Main St., P.O. Box 1261, Westboro, MA 01581
(800) 525-3577 (508) 898-2770 FAX (508) 898-9662

Inquiry 769.

THE BUYER'S MART

SOFTWARE/GRAPHICS

SCIENTIFIC VISUALIZATION

Graphics library for VGA and ET4000 Super VGA boards. Over 75 routines callable from MS FORTRAN. Up to 1024x768 in 256 colors. 2-D & 3-D w/perspective. Gouraud shaded polygons. Hidden surface removal. Animation. Mouse & joystick support. Scale and rotate text. Store/retrieve in PCX format. \$100 postpaid. No royalties. Call for free demo disk.

AEROSOFT CORPORATION

5562 Bells Ferry Rd., Suite 233, Acworth, GA 30102
Tel/FAX: (404) 917-1309

Develop CAD/CAM, GIS, A/E/C Products ON TIME and UNDER BUDGET with the "CAD/CAM Developer's Kit" Series

The CCDKs are libraries of C functions which support routines for DXF Input/output, graphical display, line/arc/ellipse/NURB spline construction/editing, and much more than can be described here.

Building Block Software, Inc.

371 Moody Street, Waltham, MA 02154
Voice (617) 899-4350 Fax (617) 899-4399

"The Ultimate CAD/CAM/CAE Programming Engine"

Slash development time with TG-Professional v.4.0, the most complete C/C++ toolbox of 2D & 3D geometric routines available today! Over 800 routines including NURBS, DXF, Graphics, Surfacing, Hidden Line, Transforms, Perspectives, Polygon (Int/Union/Diff), Clipping, Tangents, Graphics routines for drawing using BGI or MSC Graphics and more. Full source. 30 day guarantee. USA \$500.00, Foreign \$565.00US. Use MSC, Borland C/C++, WATCOM C/C++ or Metaware High C/C++. Call 1-800-635-7760 or Fax/Phone 214-423-7268 for free technical information.

Disk Software Inc.

2116 E. Arapaho Rd., Suite 467, Richardson, TX USA 75081

Inquiry 770.

RAINDROP™

FAST, compact PtiScrn Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 14 video graphic standards. Scale, rotate, colorize and more. "CALL" from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library \$44.95 + \$3 s/h.

ECLECTIC SYSTEMS

8106 St. David Ct., Springfield, VA 22153
(703) 440-0064 Fax (703) 455-8965

Inquiry 771.

SOFTWARE/GUI

GUI TOOLKIT ONLY \$249

Full source code included

TEGL Windows Toolkit lets you create DOS based GUI apps that are completely standalone. Over 500 functions. Menus, mouse & keyboard support, dialogues, and more. Includes TEGL graphics interface which has drivers for most popular video modes. Supports most C and Pascal compilers. Protected mode version is only \$499. No royalties.

TEGL Systems Corporation

P.O. Box 580, Stn. A, Vancouver B.C. V6C 2N2
(604) 669-2577 FAX (604) 688-9530

Inquiry 772.

SOFTWARE/MATHEMATICS

OPERATIONS RESEARCH @ \$149 for your IBM or Compatible

LP88-Linear Programs up to 3000 by 15000.
BLP88-Linear Programs with Bounded Variables.
MLP88-Mixed-Integer Linear Programs.
MXLP88-Large Model Mixed-Integer LP.
TSA88-Transportation/Transshipment Problems.
NLP88-Nonlinear Objective Programs.
Student/Demo-Reduced capacity versions for students.
Turbo Pascal Units-Object modules for developers

Eastern Software Products, Inc.

P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600, Fax (703) 360-7654

Inquiry 773.

SOFTWARE/PACKAGING

FREE SOFTWARE PACKAGING CATALOG

Everything you will need to Package, Distribute, and Ship Your Software! From manuals and binders to mailers and shippers

LABELS • LABELS • LABELS

For your diskettes, plain or custom printed dot matrix or laser printer... free samples

FREE CATALOG

Hice & Associates

8586 Monticello Dr., West Chester, OH 45069
Phone/Fax: 513-777-8586

Inquiry 774.

SOFTWARE/SCIENTIFIC

Scientific Image Analysis

EarthView software provides scientific floating point and complex data types, unlimited image size, programmability using over 100 basic image operators and runs on a standard MS-DOS 386/486 PC. Format support includes CEOS, DTED, MFF, TIFF, GIF and PCX. For more information on:

EarthView

contact: Atlantis Scientific, 1827 Woodward Dr.,
Ottawa Canada, K2C 0P9
tel: (613) 727-1087 fax: (613) 727-5853

Inquiry 775.

Weather Monitor & Weatherlink!

The ultimate in weather monitoring systems! A state-of-the-art weather station and a PC link allow you to view, record, summarize, and graph weather information. The perfect marriage of computer and weather technology.

DAVIS INSTRUMENTS

3465 Diablo Avenue, Hayward, CA 94545
1-800-678-3669 FAX 1-510-670-0589

Inquiry 776.

NEW! MathViews™ for Windows

MATLAB compatible interpreter for Windows

- Matrix and Array Algebra
- Complex Numbers and Signal Processing
- 2D and 3D Graphics with Clipboard Support
- Written in C++ / Available for OEM
- Introductory Price \$495.00

The MathWizards

(619) 457-2971 FAX (619) 458-5849
Trademarks are the properties of their respective owners.

Inquiry 777.

VT_EX Scientific Desktop Publishing

- Equations • Tables • Graphics • Scalable Fonts • Supports most printers • WYSIWYG previewer • Foreign Languages • Special Symbols • Font Effects • Indices • Only \$299

"T_EX of Tomorrow"-Notices of AMS, March 1991.

MicroPress, Inc.

68-30 Harrow Street, Forest Hills, NY
Tel (718) 575-18 16 Fax (718) 575-8038

Inquiry 778.

FREE CATALOG

A great selection of scientific software products for plotting, non-linear curve fitting, chemical equilibrium, simulation, statistics, symbolic algebra, and more. Prices from \$150. Call:

1-801-943-0290

MicroMath, Salt Lake City, UT 84121-0550

Inquiry 779.

SOFTWARE/SCIENTIFIC

OVER 300 PROGRAMS AVAILABLE! FREE CATALOG!

- COGO Routines
- Surface Modeling
- Gridding & Contouring
- Groundwater Modeling
- Molecular Modeling
- Astronomy
- Geophysics
- Base Mapping
- Log Plotting & Analysis
- Petroleum Databases
- Oil & Gas Economics
- USGS Digital Elevation Quads
- Data Conversion
- Statistical Analysis & Plotting
- Geo & Hydro Chemical Analysis
- Hydrodynamic Modeling

RockWare

(303) 423-5645 • Fax (303) 423-6171 • RockFAX* (303) 423-7112
*24-hr. fax on-demand product information service

Inquiry 780.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS \$149. OS/2, XENIX, UNIX \$249.

(702) 588-3737

Opt-Tech Data Processing

P.O. Box 678 - Zephyr Cove, NV 89448

Inquiry 781.

SOFTWARE/VOICE/FAX

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access all the features for most speech processing boards available today. It helps you write MULTI-LINE VOICE APPLICATION systems in minutes. A number of programming examples are provided. All programs and libraries are delivered with source code.

Dialogic, Rhetorex, Pika, VBX: \$599. Watson (Single Line): \$99. ALSO AVAILABLE: Fax Programmer's Toolkit (\$199). Based on CAS specifications. Visa/MC accepted.

ITI Logiciel

4263 Cristophe-Colomb, Montreal, Quebec, Can. H2J 3G2
TEL (514) 597-1692 FAX (514) 526-2362

STATISTICS

VISUALIZE YOUR DATA

MCA+ transforms most marketing and social science data to easily understood perceptual maps. Communicate complex relations with ease using presentation quality charts. Most printers supported. Demos available.

Bretton-Clark

89 Headquarters Plaza, Morristown, NJ 07960
(201) 993-3135 FAX: (201) 993-1757

Inquiry 782.

NCSS 5.x Series - \$125

Easy-to-use menus & spread sheet. Multiple regression. T-tests. ANOVA (up to 10 factors, rep. measures, covariance). Forecasting. Factor, cluster, & discriminant analysis. Nonparametrics. Cross Tabulation. Graphics: histograms, box, scatter, etc. Reads ASCII/Lotus. Many new add-on modules.

NCSS

329 North 1000 East, Kaysville, UT 84037

Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 783.

TRANSLATION

SOFTWARE LOCALIZATION

Since 1980, IDOC has translated hundreds of packages for the world's most prominent computer firms: Ashton-Tate, Borland, HP, Sun Microsystems, Novell and many more. We offer FULL SOFTWARE ADAPTATION WITH IN-HOUSE ENGINEERING, TRANSLATION INTO ALL MAJOR LANGUAGES WITH IN-HOUSE LINGUISTS, DTP SPECIALISTS, AND EDITORS. With production and sales offices in Los Angeles, Dublin, Milan, Buenos Aires, and Tokyo (Fall 92). IDOC is the leader in worldwide translation services.

IDOC, an International Documentation Company

1-800-336-9898 (U.S.) 353-1-284-4223 (Europe)
10474 Santa Monica Blvd, Suite 404, Los Angeles, CA 90025

Inquiry 784.

YOUR DIRECT LINK

ADVERTISER CONTACT INFORMATION

To order products or request FREE information, call advertisers directly or send in the Direct Link Card by mail or fax! Let them know you saw it in **BYTE**!

Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.
* 900 DISCOUNT SHOPPER	349	219-256-3020	497-498 COMTRADE	333	800-969-2123	64 IO COMM	227	310-644-6100
242 AT&T PARADYNE (N.A.)	99-101	800-544-4996 96	484 COPO INFOSYSTEMS AMER	340PC-8-9	408-943-9007	307 IO TECH	353	216-439-4091
294-295 AAEON	352	886-2-218-2463**	385-386 CORE INT'L	208IS-1	407-997-6044	308 IO TECH	354	216-439-4091
76-77 ABACUS SOFTWARE	143	800-451-4319	110 COREL SOFTWARE	44	800-836-SCSI	402-403 ISLAND SYSTEMS (INT'L)	292IS-2	617-273-0421
372-373 ABC COMPUTER	292IS-1	310-325-6369	368 CORPORATE HI TECH SERV	252UK-2	44-0793-611-437**	427 ITALIAN SOFTWARE AGENCY (INT'L)	277	39-323-925028**
287-288 ABC COMPUTER (USA) CORP	320	310-325-4005	227 CREATIVE LABS INC	69	800-998-LABS	346 IVERSON SOFTWARE, INC	358	416-925-6096
292-293 ACCESS SOFTWARE	346-347	800-739-0073	500-501 CTX INT'L INC	291	714-595-6146	65 JAMECO ELECTRONICS	228-229	800-831-4242
457-458 ACER PERIPHERALS	184IS-15		111 CURTIS INC	298	612-631-9512	* JDR MICRODEVICES	311	800-538-5000
343-344 ACI / ACQUIRE	350	886-2-758-9615**	392-397 CYBER RESEARCH	326-327	800-394-3300	422 JEN ELECTRONICA	268IS-4	39-733-322403**
233 ACTIX SYSTEMS	174	800-927-5557	261 CYBEX CORP	328	205-534-0010**	309 JENSEN TOOLS	350	602-968-6231
225-226 ADDA	274	886-2-248-4276**	387 CYBEX CORP (INT'L)	CIII	205-534-0010**	* JNL OF OBJ ORIENT PROGRAMMING	176IDRC-1	212-274-0640
262-263 ADVANCED COMPUTER INT'L	340MW-3	800-354-1828	112-113 CYRIX	152	800-FAS-MATH	144 KEA SYSTEMS LTD	114	800-663-8702
487-488 ADVANCED COMPUTER INT'L	340SO-1	800-354-1828	* C++ REPORT	176IDRC-3-4	212-274-0640	310 KILA	350	303-444-7737
504-505 ADVANCED COMPUTER INT'L	340NE-2	800-354-1828	433 C.E.T.R.A.	184IS-7	886-2-725-1314**	460-461 KINGLI TECHNOLOGY, INC	340MW-2	800-788-0622
506-507 ADVANCED COMPUTER INT'L	340PC-12	800-354-1828	362-363 C.P. RESEARCH	352	207-622-1867	469-469 KINGLI TECHNOLOGY, INC	340NE-6	800-788-0622
256-257 ADVANCED COMPUTER PROD	341	714-558-8813	428 DAEWOO	184IS-1	31-2503-37214**	510-511 KINGSTON TECHNOLOGY	215	714-435-2600
61-62 ADVANCED LOGIC RESEARCH	211	714-581-6770	255 DALLAS SEMICONDUCTOR	103	800-258-5061	434-435 KUO FENG CORP	184IS-17	886-2-754-8498**
83 ADVANCED MICRO DEVICES	10-11	800-222-9323	365 DAN TECHNOLOGY PLC	240UK-1	44-81-902-3300**	311 LAGUNA DATA SYSTEMS	354	800-859-8856
345 ADVANCED MICRO TECH	349	714-598-6120	114-115 DATA ACCESS CORP	166	800-451-FLEX	145 LAHEY COMPUTER SYSTEMS	252	800-548-4778
79 AITECH	258	800-882-8184	116-117 DATALUX CORP	190	800-DATALUX	198-199 LANDMARK RESEARCH INT'L CORP	151	800-683-6696
78 ALADDIN KNOWLEDGE SYS	116	800-223-4277	364 DATAMAN LTD	252UK-3	44-0300-21012**	283-284 LAPINE	339	800-927-3772
374 ALADDIN KNOWLEDGE SYS	268IS-2	800-223-4277	388-389 DATATRONICS TECH	292IS-2	882-2-782-0305**	337 L-COM, INC	350	508-682-6936
473 ALADDIN KNOWLEDGE SYS	340PC-11	800-223-4277	339 DAVIS INSTRUMENTS	353	800-678-3669	228-229 LEXMARK INTERNATIONAL	73	606-232-6814
519 ALADDIN KNOWLEDGE SYS	340PC-10	800-223-4277	351-352 DAVISON-WORTH CORP	356	800-668-2707	312 LINK COMPUTER GRAPHICS	354	201-808-8990
80-82 ALPHATRONIX	157	800-849-5807	118-119 DCA	59	800-348-3221 ext. 27DD	276 LODE STAR COMPUTER	308-309	800-875-7568
* AME INSTIT FOR COMP SCI	356	205-323-6191	96 DECISIONS	371		404 LOGIC PROGRAMMING ASSOC	284IS-2	44-81-874-0449**
* AMERICA ONLINE INC	176A-B	800-827-6364	120 DELL COMPUTER CORP (N.A.)	CIII	800-626-8260	235-236 MAG INNOVATION	37	800-827-3998
296 AMERICAN ADVANTECH	352	800-800-6889	121 DELL COMPUTER CORP (N.A.)	CIV	800-626-8260	* MAGIC / MSE (INT'L)	176IS-3	972-3-751-1901**
84-85 AMERICAN MEGATRENDS	115	800-828-9264	429 DEXDENE	184IS-2	44-285-65644**	* MANCHESTER EQUIP CO	340NE-A-B	516-435-1199
86 AMERICAN SMALL BUSI COMP	271	918-825-4844	476 DEXPO / MILLER FREEMAN, INC	340PC-4	800-87-DEXPO	466 MANCHESTER EQUIP CO	340NE-1	516-435-1199
485 AMS	340PC-1	800-888-6615	474-475 DHT	340PC-2-3	818-810-0552	* MARK WILLIAMS CO	97	800-627-5967
258 AMT INTERNATIONAL	346	408-942-9695	508-509 DIAGSOFT INC	298	800-DIAGSOFT	147 MATHSOFT INC	263	800-628-4223
196 APL * PLUS / MANUGISTICS	105	800-592-0050 ext. 875	514 DIETRICH POS EQUIPMENT	276IS-2	49-761-5 68 81**	148 MATHSOFT INC	263	800-628-4223
478 APPRO INTERNATIONAL INC	340PC-7	408-732-6091	438-439 DIGICOM INC	184IS-13	886-2-721-4052**	149 MATROX VIDEO PRODUCTS GRP	284	514-685-2630
486 APPRO INTERNATIONAL INC	340SO-3	408-732-6091	358 DIGITAL SOUP INC	358	800-793-7356	406-407 MEGADATA	276IS-4	516-589-6588**
424 ARABIC PUBLISHER	284IS-2	357-2-448352**	122 DIGITAL VISION	164	800-346-0900	291 MEGAMEDIA COMPUTER CORP	334	800-634-2633
87-88 ARC SOFTWARE	268	800-SKY-1642	298 DIVERSIFIED COMPUTER	355	303-447-9251	335 MEMORY SUPERSTORE	352	800-800-7056
248 ARES MICRO DEVELOPMENT	34-35	800-322-3200	123 DOLCH COMPUTER SYS	79	800-995-7581	308 METALINK CORP	354	800-638-2323
90 ASP COMPUTER PRODUCTS	234	408-746-2965	262-263 DPT	325	407-830-5522	408 MICRO DESIGN INT'L	176IS-4	407-677-8433
89 ATI TECHNOLOGIES INC	207	416-756-0718	520 DURACELL	38-39	203-791-3291	268 MICRO SOLUTIONS COMP PROD	319	815-756-3411
448-449 AUTO COMPUTER CO. LTD	184IS-11	886-3-452-9155**	472 DYNALOG API	340NE-3	313-661-5826**	502 MICROGRAFX	289	214-234-1769
91 AUTODESK INC	171	800-964-6432	282 DYNAMICSCAN	316-317	314-423-0044	280-281 MICRO-INTERNATIONAL, INC	338	800-967-5667
360-361 AVC	353	886-2-299-6929	425 ECG	284IS-1	31-4937-96808**	150-151 MICRONET TECHNOLOGY	203	714-837-6033
92-93 BAY TECHNICAL ASSOC	54	800-523-2702	* ELONEX (INT'L)	100-101	44-81-452-6422**	267 MICROPROSE SOFTWARE	329	800-879-PLAY
391 BEST POWER TECHNOLOGIES	321-324	800-356-5794	347 EMPIRE COMPUTECH	353	800-446-1967	152 MICROSOFT PRESS INC	110	800-MSPRESS
* BEST POWER TECHNOLOGIES	324A-B	800-356-5794	522-523 EVOLUTION COMPUTING	340	800-874-4028	313 MICROSTAR LABORATORIES	356	206-453-2345
* BINARY TECHNOLOGY INC	358	508-369-9556	124-125 EXABYTE CORP	251	800-392-2983	421 MICROWAY	199	508-746-7341
450 BIX	371	617-491-3342	390 FAST ELECTRONIC GMBH	184IS-3	49-089-533-401**	153 MINICOM LTD	184IS-2	972-2-637576**
512 BLINK INC	305	804-355-4444	264-265 FIRST SOURCE INT'L	332	714-588-9866	409 MINOLTA GMBH (INT'L)	99	49-0511-779089**
94-95 BORLAND INT'L	13-17,83	800-331-0877	* FRAME TECHNOLOGY	168A-B	800-U4FRAME	164 MINUTEMAN	113	214-446-7363
375-376 BORLAND INT'L	CIV		126 FRAME TECHNOLOGY	169	800-U4FRAME	451-452 MITAC	184IS-5	886-2-501-4265**
399 BUFFALO PRODUCTS	315	800-345-2356	127-128 FTP SOFTWARE (N.A.)	62	617-246-0900	154 MIX SOFTWARE	300	214-783-6061
259 BULLDOG COMPUTER PROD	337	800-438-6039	299-300 GAGE APPLIED SCIENCES, INC	351	514-337-6893	155 MKS / MORTICE KERN SYS	248	519-884-2251
* BYTE BUYER'S MART	176IDRC-3-4	603-924-2656	* GATEWAY 2000	CII,CHIA-B	800-523-2000	446-447 MOXA	184IS-10	886-2-363-1431**
* BYTE CARD DECK	176IDRC-3-4	603-924-2596	* GATEWAY 2000	1	800-523-2000	359 MPI MARKETING	355	714-468-5555
* BYTE REPRINTS	292	603-924-2525	516-517 GENOA SYSTEMS	111	408-432-9090	156-157 NANO USA CORP	178-179	310-325-5202
* BYTE SUB MESSAGE	270		398 GFK HAMBURG	284IS-3	49-040-231-789**	269-270 NATIONAL DESIGN	310	800-253-8831
341 CADSOFT COMPUTER, INC	355	800-858-8355	129-130 GLENCO ENGINEERING	197	800-562-2543	158 NATIONAL INSTRUMENTS	9	800-433-3488
249 CANON INFORMATION SYS	60-61	800-OKCANON	301 GLOBALINK INC	358	800-255-5660	314 NATIONAL INSTRUMENTS	356	800-433-3488
97 CANON USA INC	112	800-221-3333	302 GMM RESEARCH CORP	350	714-752-9447	* NATIONAL INSTRUMENTS	176IDRC-1-2	512-794-0100
98 CAPITAL EQUIPMENT CO	186	800-234-4232	131 GRAFFPOINT INC	274	800-426-2230	499 NATIONAL VIDEOTECH	163	800-336-9096
99 CAPITAL EQUIPMENT CO	187	800-234-4232	340 GRAMMAR ENGINE, INC	356	614-899-7878	159 NEC / PRINTERS	48-49	800-388-8888
243-244 CASE DESIGN INT'L	191	800-880-1100	303 GREENLEAF SOFTWARE	357	800-523-9830	521 NEC / MONITORS	74-75	800-NEC-INFO
237 CASTELLE CORP	41	800-359-7654	400 GREY MATTER LTD	268IS-3	44-0364-53071**	230 NETWORK COMPUTING DEV	201	800-800-9599
431-432 CATHAY COMPUTER & TECH	184IS-19	886-2-506-8929**	304 GTEK INC	350	800-282-4835	494-495 NETWORK EXPRESS	348	800-946-9899
377-378 CHERRY			401 HANTAREX SPA	268IS-1	39-55-49-73364**	266 NEVADA COMPUTER	330-331	800-654-7762
353-354 CHIA SHIN	208IS-2-3	49-964-318-262**	355 HARPER COLLINS	349	44-0903-873633**	160 NEW MEDIA GRAPHICS CORP	290	800-288-2207
278 CITITRONICS	318	818-855-5688	132 HAUPPAUGE COMP WORKS	53	800-443-6284	* NORTHGATE COMP SYS	344	800-345-8709
379-380 CLARION SOFTWARE	184IS-4	305-785-4555	133 HEWLETT PACKARD	30-31	800-554-1305	430 OMNI PLUS	276IS-4	602-396-3616
100-101 COLORADO MEMORY SYS	63	800-346-9881	* HEWLETT PACKARD	88-89	800-554-1305	423 ON TIME MKT / KARSTEN PETERSEN	276IS-2	49-040-435-196**
102 COMMODORE	87	800-66-AMIGA	* HEWLETT PACKARD	117	800-752-0900	66-67 OPTIQUEST	213	310-948-1185
103 COMPAQ COMPUTER CORP	20-21	800-345-1518	* HEWLETT PACKARD	118	800-752-0900	161-162 ORCHID TECHNOLOGY	280	800-7-ORCHID
381-382 COMPEX INC	276IS-1	714-630-7302	* HEWLETT PACKARD	119	800-752-0900	163 OSBORNE MCGRAW-HILL	106-108	
241 COMPUPLYNE	26-27	800-932-COMP	* HEWLETT PACKARD	120-121	800-752-0900	334 OSCS	358	800-545-1392
383 COMPUSAVE INT'L	208IS-4	602-437-8208	305 HIGH-RES TECHNOLOGIES	353	416-497-6493	* OUTPUT TECHNOLOGY CO	25	800-468-8778
* COMPUSERVE	152A-B	800-848-8199	306 HI-TECH INSTRUMENTS	349	713-980-9040	315 OVERLAND DATA INC	355	800-729-8725
104 COMPUSERVE	153	800-848-8199	135 HUMMINGBIRD COMMNCNTNS	275	416-470-1207	410 OXFORD		
105 COMPUTER ASSOCIATES	33	800-CALL-CAI	136 IBM / LEXMARK	84-85	800-358-5835	* ELECTRONIC PUBLISHING	276IS-4	44-865-5664**
107 COMPUTER ASSOCIATES	71	800-CALL-CAI	137 IBM / OS2	56-57	800-3IBM-OS2	* PACIFIC DATA PRODUCTS	243	619-825-3591
108 COMPUTER ASSOCIATES	80-81	800-CALL-CAI	513 IBM / WORKSTATIONS	173	800-IBM-6676 ext. 723	74-75 PARALLEL PERIPHERALS	235	714-394-7244
106 COMPUTER ASSOCIATES	138	800-CALL-CAI	367 ICONOGRAPHIC SYSTEMS	240UK-2	44-0280-823-314**	165 PATTON & PATTON	170	800-525-0082
109 COMPUTER FRIENDS	268	800-547-3303	* INSIGHT DISTRIBUTION NTWK	232-233	800-755-3874	166-167 PC POWER & COOLING	55	800-722-6555
384 COMPUTER QUICK	62	415-861-8330	140 INTEGRAND RESEARCH	206	209-651-1203	168-169 PERCEPTIVE SOLUTIONS	244	800-486-3278
370 COMPUTER TELECOMCNCTS	240UK-2	44-252-835315**	138-139 INTEGRATED INFO TECH	287	800-832-0770	170-171 PERISCOPE COMPANY, THE	176	800-722-7006
260 COMPUTERLANE UNLIMITED	343	800-526-3482	63 INTEL CORP	222-223	800-538-3373	172 PERSONAL TEX	292	415-388-8853
297 COMPUTERWISE	356	800-255-3739	141-143 INTERGRAPH (N.A.)	92-93	800-345-4856			

YOUR DIRECT LINK

ADVERTISER CONTACT INFORMATION

Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.
173 PHAR LAP SOFTWARE INC	47	617-661-1510	455-456 SINETEC TECHNOLOGY	184IST-20	886-2-225-0485**	323 TRIANGLE DIGITAL SERVICES	35144-81-558-8110**	
411 PHILIPS MONITORS (INT'L)	92-93 31	40-73-39-83**	342 SMARTMICRO TECHNOLOGIES	352	800-266-1576	324-325 TRIBAL MICROSYSTEMS	354	510-623-8859
174-175 PINNACLE MICRO	6-7	714-727-3300	186 S'NW ELECTRONICS	252	800-874-1235	207-208 TRIPP LITE	122	312-329-1777
176 PIONEER COMMUNICATIONS	141	800-LASER-ON	* SOFTLINE CORP	176IS-1	718-438-6057	417 TRITON TECHNOLOGIES	176IS-2	908-855-9440
177 PKWARE INC	168	414-354-8699	187-188 SOFTWARE SECURITY INC	64	203-329-8870	271 TRUE DATA PRODUCTS	336	800-635-0300
479 POLSTEK USA, INC	340PC-6	408-980-1234	189 SONY CPMC	184A-H	800-352-7669	209-210 TRUEVISION INC	149	800-344-8783
316 PLUSTAR CORP	349	800-225-2270	493 SONY (N.A.)	205		211 TURBOPOWER SOFTWARE	282	800-333-4160
440-441 PORC CORP	184IST-12	886-2-883582**	190 SPECTRUM SOFTWARE (N.A.)	277	408-738-4387	418-419 UNIAIR	292IS-4	886-2-2993210**
477 PROFESSIONAL COMPUTER	340PC-5	408-263-0222	191 SPSS INC	147	800-543-5835	* UNICODE CONSORTIUM	276IS-2	
146 PROGRAMMER'S PARADISE	65-67	800-445-7899	192-193 STATSOFT	237	918-583-4149	* UNIXWORLD	284A-B	800-257-9402
* PROGRAMMER'S SHOP	124-126	800-421-8006	253-254 STORAGE DEVICES INC	181	714-562-5500	* UNIXWORLD	284A-B	800-257-9402
68 PROMISE TECHNOLOGY	225	800-888-0245	194 STORAGE DIMENSIONS	264	408-954-0710	326 UPGRADES ETC	353	800-955-3527
231-232 PROXIMA CORP	241	619-457-5500	195 STORAGE DIMENSIONS	273	800-765-7895	357 USA ELECTRONICS, INC	352	800-332-8434
317 PSEUDOCORP	358	804-873-1947	426 STRUCTURED S/W SOLU	268IS-2	214-985-9901	212-213 VENTURA SOFTWARE INC	247	800-822-8221
178 QNX / QUANTUM SOFTWARE SYS	283	800-363-9001 ext. 101	197 SUMMAGRAPHS CORP	259	800-729-7866	214 VERBATIM CORP	159	
			459 SUMMIT MICRO DESIGN	340MW-1	408-739-6348	* VERMONT CREATIVE S/W	23	800-848-1248
			467 SUMMIT MICRO DESIGN	340NE-5	408-739-6348	215 VERSASOFT	96	408-723-9044
			238 SUNSOFT	2-3	800-727-9227 ext. 123	216 VIDEK, INC	8	503-758-0521
179 QUA TECH INC	306	800-553-1170	234 SUPRA CORP	175	800-727-8647	217-218 VIEWSONIC	245	714-869-7976
318 QUALSTAR CORP	355	818-882-5822	356 SURPLUS SOFTWARE INT'L	357	800-753-7877	245-247 VILLA CRESPO SOFTWARE LTD	165	800-521-3963
515 QUARTERDECK OFFICE SYS	144QD-1-32	310-392-9851	223 SYMANTEC	137	800-228-4122	327 VISTA MICROSYSTEMS	357	508-695-8459
* QUARTERDECK OFFICE SYS	144QD-33-34	310-392-9851	200-201 SYSTAT INC	123	708-864-5670	420 WALKER, RICHER & QUINN (INT'L)	205	208-324-0407
369 QUIN SYSTEMS LTD	252UK-1	44-734-776728**	412 SZKI RECOGNITA CORP	276IS-3	361-201-7807**	219 WATCOM PRODUCTS INC	29	800-265-4555
180 RAIMA CORP	95	800-327-2462	321 TALKING TECHNOLOGY INC	350	800-685-4884	220 WATCOM PRODUCTS INC	91	800-265-4555
69-70 RAINBOW TECHNOLOGIES	212	800-852-8569	436-437 TATUNG CO	184IST-9	886-2-598-4509**	366 WESTPOINT CREATIVE	240UK-3	44-0743-248-199**
71-72 RAINBOW TECHNOLOGIES	231	800-852-8569	415-416 TECHPOWER COMPANY LTD	284IS-4	886-2-753-1940**	328 WINTK CORP	355	800-742-6809
285 RALIN WHOLESALERS	312-313	800-752-9512	202 TEKTRONIX	260	800-835-6100	377 WORLDWIDE TECHNOLOGIES	342	800-457-6937
* REASONABLE SOLUTIONS	176IDRC-1-2	503-776-5777	453-454 TELESPEED	184IST-20	886-2-723-6920**	329 XELTEK	354	408-524-1929
274-275 RECOTEC INC	314	800-729-7654	203 TEXAS INSTRUMENTS	267	800-527-3500	221-222 XVIT SOFTWARE INC	19	800-678-7988
181 ROSE ELECTRONICS	214	800-333-9343	333 TIEPIE ENGINEERING	351	31-5106-704**	480-481 YUAN TECHNOLOGY INC	340PC-11	802-966-1557
182 ROSE ELECTRONICS	272	800-333-9343	444-445 TOPTEK	184IST-3	886-2-961-9586**	422-423 ZECKS	184IST-14	886-2-299-2027**
371 R.E.M.	240UK-4	44-71**436-4420**	204 TOSHIBA AMERICA INC	42-43	800-457-7777	73 ZEOS INTERNATIONAL	216-217	800-423-5891
139 SAS INSTITUTE INC	357	919-677-8000	496 TOTE-A-LAP	345	800-9-9-LAPTOP	330 Z-WORLD ENGINEERING	354	916-757-3737
383-184 SECURE IT INC	288	800-451-7592	205-206 TOUCHSTONE SOFTWARE	184	714-969-7746	224 ZYLAB / DIVISION OF IDI	288	800-544-6339
279 SECURITECH COMPANY	347	503-636-6831	289-290 TRANSCEND INFORMATION INC	335	714-598-5500	239-240 ZYXEL USA	183	714-693-0808
413-414 SEKISUI CHEMICAL CO LTD	284IS-4	81-06-365-4375**	331 TRANTOR SYSTEMS LTD	351	800-872-6867			
185 SEQUITER SOFTWARE INC	255	403-437-2410	332 TRI VALLEY TECHNOLOGY INC	351	510-447-2030			
322 SIGEN	351	408-737-3904						
349-350 SIGMA TECH SOFTWARE	350	818-368-6132						
320 SILICON SHACK	353	800-969-4411						

* Correspond directly with company.
** Indicates FAX Number

BYTE ADVERTISING SALES STAFF

Jennifer L. Bartel, National Sales Manager, 14850 Quorum Drive, Suite 380, Dallas, TX 75240, Tel. (214) 701-8496
Liz Coymann, Inside Advertising Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, Tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO
CANADA & EASTERN CANADA
Michael Lamatina (617) 860-6344
Patricia Payne (603) 924-2654
McGraw-Hill Publications
24 Hartwell Avenue
Lexington, MA 02173
FAX: (617) 860-6899

EAST COAST
NY, NYC, NJ, DC, DE, MD, VA, WV, PA
Kim Norris (212) 512-2645
Ariane Casey (212) 512-2368
Barry Echavarría (603) 924-2574
McGraw-Hill Publications
1221 Avenue of Americas—
28th Floor
New York, NY 10020
FAX: (212) 512-2075

SOUTHEAST
NC, SC, GA, FL, AL, TN, MS, AR, LA, KY
MaryAnn Gauding (404) 843-4782
McGraw-Hill Publications
4170 Ashford-Dunwoody Rd., Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN,
WI, NE, IN, MI, OH
Kurt Kelley (312) 616-3328
Ed Ware (603) 924-2664
McGraw-Hill Publications
Two Prudential Plaza
180 North Station Ave.
Chicago, IL 60601
FAX: (312) 616-3370

SOUTHWEST
ROCKY MOUNTAIN
CO, OK, TX
Jennifer Walker (214) 701-8496
Barry Echavarría (603) 924-2574
McGraw-Hill Publications
14850 Quorum Dr., Suite 380
Dallas, TX 75240
FAX: (214) 991-6208

NORTH PACIFIC: San Francisco, CA
NORTHERN CA, OR, ID, MT,
WY, NORTHERN NV, UT
Roy J. Kops (415) 954-9728
Joseph Mabe (603) 924-2662
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

NORTH PACIFIC: Campbell, CA
SILICON VALLEY, HI, WA, AK,
W. CANADA
Bill McAlister (408) 879-0381
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
1999 South Bascom Ave., Suite 210
Campbell, CA 95008
FAX: (408) 879-9067

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ,
NM, SOUTHERN NEVADA
Alan El Faye (213) 480-5243
Jonathan Sawyer (603) 924-2665
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

SOUTH PACIFIC: Costa Mesa, CA
ORANGE COUNTY
SAN DIEGO COUNTY
Beth Dudas (714) 753-8140
Joseph Mabe (603) 924-2662
McGraw-Hill Publications
15635 Alton Pkwy., Suite 290
Irvine, CA 92718
FAX: (714) 753-8147

Regional Advertising
Brian Higgins (603) 924-2651
Larry Levine (603) 924-2637
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE International Direct Response Postcards
Ellen Perham (603) 924-2598
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office: Inside Sales FAX: 603-924-2683 Advertising FAX: 603-924-7507

Hardware/Software Showcase
Mark Stone (603) 924-2695
Ellen Perham (603) 924-2598
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart/Classifieds
Margot Gnade (603) 924-2656
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck
Brad Dixon (603) 924-2596
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

EURO-DECK
James Ball (603) 924-2533
McGraw-Hill Publications
One Phoenix Mill Lane
Peterborough, NH 03458

INTERNATIONAL ADVERTISING SALES STAFF

Ron Cordek, Managing Director, European Operations
McGraw-Hill Publishing Co., Wimbledon Bridge House, One Hartfield Road, Wimbledon, London SW19 3RU, England, Tel: 44 81 545 6278, Fax: 44 81 545 6294

GERMANY, SWITZERLAND, AUSTRIA
Christina Barion
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
Tel: +44 81 5456270
FAX: +44 81 5456294
TELEX: 892191

BENELUX
Ellen Pardede
Batenburg 105
3437 AB Nieuwegein
The Netherlands
Tel: +31 34 0249486
FAX: +31 34 0237944

UNITED KINGDOM
Michele Hams (44 81 545 6269)
Christina Barion (44 81 545 6270)
McGraw-Hill Publishing Co.
Wimbledon Bridge House
One Hartfield Road
Wimbledon, London SW19 3RU
England
Tel: +44 81 5456294
TELEX: 892191

FRANCE, ITALY
Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: +44 71 2843171
FAX: +44 71 2843174

SCANDINAVIAN COUNTRIES
Zena Coupé
A-Z International Sales Ltd.
70 Chalk Farm Road
London NW1 8AN
England
Tel: +44 71 2843171
FAX: +44 71 2843174

ISRAEL
Dan Ehrlich
Ehrlich Communication Intl.
P.O. Box 99
Herzliya 46101, Israel
Tel: +972 52 586245
Tel: +972 52 586246
FAX: +972 52 585885

AUSTRALIA
Rod Tremain
Rod Tremain Media
45 Pymble Ave.
Pymble 2073, Sydney
Australia
Tel: +61 2 9983339
FAX: +61 2 9883424

JAPAN
Masaki Mori
Transworld Media Inc.
4th Floor, 1-26-6 Kamimeguro
Meguro-ku, Tokyo 153, Japan
Tel: +81 3 57210761
FAX: +81 3 57210762

KOREA
Young-Seoh Chinn
JES MEDIA INT'L
5th Floor, Banpo Bldg.
40-7, Chamwon-Dong, Seocho-Gu
Seoul 137-030, Korea
Tel: +82 2 5458001
Tel: +82 2 5458002
FAX: +82 2 5458861

SINGAPORE
Derek Ng
Stephen Tay
Acer TWP Corp.
1123 Serangoon Road, #03-01
Singapore 1232
Tel: +65 296 6166
FAX: +65 296 7551

MALAYSIA
Servex (Malaysia) Sdn. Bhd.
H.K. Lin
5th Floor, Bena Tower
160, Jalan Ampang
50450 Kuala Lumpur, Malaysia
Tel: +60 3 2624592
FAX: +60 3 2624591

THAILAND
Jack Hu
28/1 Prapawit Bldg., Surasak Rd.
Silom, Bangkok 10500
Thailand
Tel: +66 2 2360295
FAX: +66 2 2365960

HONG KONG
Candice Lo
Acer TWP Corp.
Unit 2, 6F Hing Wah Center
82-84 To Kwa Wan Road
Kowloon, Hong Kong
Tel: +852 764 3830
FAX: +852 764 3857

INDIA, INDONESIA, PAKISTAN, PHILIPPINES, TAIWAN, OTHER ASIAN AND PACIFIC COUNTRIES
K.T. Wu
Acer TWP Corp.
2nd Fl., No. 19-1, Lane 231
Fu Hsing North Road
Taipei 10445, Taiwan
R.O.C.
Tel: +886 2 7136959
FAX: +886 2 7151950

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on Your Direct Link Card!

To receive information for an entire product category, circle the category number on Your Direct Link Card!

Category No.
Inquiry No.

Page No.

HARDWARE

1 ACCESSORIES/SUPPLIES

514	900 DISCOUNT SHOPPER	349
520	DIETRICH POS EQUIPMENT	276IS-2
316	DURACELL	38-39
183-184	PC ARROD CORPORATION	349
279	SECURE IT INC	288
442-443	SECURTECH COMPANY	347
	ZECKS	184IS-14

2 ADD-IN BOARDS

233	ACTIX SYSTEMS	174
345	ADVANCED MICRO TECHNOLOGY	349
79	AITECH	258
84-85	AMERICAN MEGATRENDS	115
89	ATI TECHNOLOGIES INCORPORATED	207
353-354	CHIA SHIN	349
381-382	COMPEX INC	276IS-1
227	CREATIVE LABS INC	69
111	CURTIS INC	298
429	DEXDYNE	184IS-2
438-439	DIGICOM INC	184IS-13
262-263	DPT	325
516-517	GENOA SYSTEMS	111
398	GFK HAMBURG	284IS-3
305	HIGH-RES TECHNOLOGIES	353
306	HI-TECH INSTRUMENTS	349
64	IO COMM	227
65	JAMECO ELECTRONICS	228-229
422	JEN ELECTRONICA	268IS-4
446-447	MOXA	184IS-10
269-270	NATIONAL DESIGN	310
161-162	ORCHID TECHNOLOGY	280
168-169	PERCEPTIVE SOLUTIONS	244
170-171	PERISCOPE COMPANY, THE	176
68	PRIMISE TECHNOLOGY	225
179	QUA TECH INC	306
285	RALIN WHOLESALERS	312-313
321	TALKING TECHNOLOGY INC	350
453-454	TELESPEED	184IS-20
444-445	TOPTek	184IS-3
209-210	TRUEVISION INC	149
366	WESTPOINT CREATIVE	240UK-3

3 BAR CODING

216	VIDEX, INC	8
-----	------------	---

4 COMMUNICATIONS/NETWORKING

92-93	BAY TECHNICAL ASSOC	54
385-386	CORE INTERNATIONAL	208IS-1
302	GMM RESEARCH CORPORATION	350
304	GTEK INC	350
309	JENSEN TOOLS	350
337	L-COM, INC	350
421	MINICOM LTD	184IS-2
494-495	NETWORK EXPRESS	235
74-75	PARALLEL PERIPHERALS	214
181	ROSE ELECTRONICS	272
182	ROSE ELECTRONICS	350
349-350	SIGMA TECH SOFTWARE	350
321	TALKING TECHNOLOGY INC	350

5 COMPUTER SYSTEMS

343-344	ACI / ACQUIRE	350
262-263	ADVANCED COMPUTER INT'L	340MW-3
487-488	ADVANCED COMPUTER INT'L	340SO-1
504-505	ADVANCED COMPUTER INT'L	340NE-2
506-507	ADVANCED COMPUTER INT'L	340PC-12
485	AMS	340PC-7
478	APPRO INTERNATIONAL INC	340SO-3
486	APPRO INTERNATIONAL INC	34-35
248	ARES MICRO DEVELOPMENT	184IS-19
431-432	CATHAY COMPUTER & TECH	87
102	COMMODORE	20-21
103	COMPAQ COMPUTER CORP	333
497-498	COMTRADE	340PC-9
484	COPO INFOSYSTEMS AMERICA	240UK-1
365	DAN TECHNOLOGY PLC	190
116-117	DATALUX CORPORATION	CII
120	DELL COMPUTER CORP (N.A.)	CIV
121	DELL COMPUTER CORP (N.A.)	340PC-2-3
474-475	DHT	184IS-13
438-439	DIGICOM INC	316-317
282	DYNAMICSCAN	284IS-1
425	ELONEX (INT'L)	100-101
*	GATEWAY 2000	CII, CIA-B
*	GATEWAY 2000	1
*	HEWLETT PACKARD	117
*	HEWLETT PACKARD	118
*	HEWLETT PACKARD	119
*	HEWLETT PACKARD	120-121
513	IBM / WORKSTATIONS	173
*	INSIGHT DISTRIBUTION NETWORK	232-233
310	KILA	350
460-461	KINGLI TECHNOLOGY, INC	340MW-2
468-469	KINGLI TECHNOLOGY, INC	340NE-6
283-284	LAPINE	339

Category No.
Inquiry No.

Page No.

*	MANCHESTER EQUIPMENT CO	340NE-A-B
466	MANCHESTER EQUIPMENT CO	340NE-1
153	MICROWAY	199
451-452	MITAC	184IS-5
*	NORTHGATE COMP SYS	344
166-167	PC POWER & COOLING	55
477	PROFESSIONAL COMPUTER	340PC-5
274-275	RECORTEC INC	314
371	R.E.M.	240UK-4
459	SUMMIT MICRO DESIGN	340MW-1
467	SUMMIT MICRO DESIGN	340NE-5
436-437	TATUNG CO	184IS-9
415-416	TECHPOWER COMPANY LTD	284IS-4
332	TRI VALLEY TECHNOLOGY INC	351
323	TRIANGLE DIGITAL SERVICES	351
271	TRUE DATA PRODUCTS	336
418-419	UNIAIR	292IS-4
73	ZEOS INTERNATIONAL	216-217

6 DATA ACQUISITION

299-300	GAGE APPLIED SCIENCES, INC	351
*	NATIONAL INSTRUMENTS	176IDRC-1-2
314	NATIONAL INSTRUMENTS	356
369	QUIN SYSTEMS LTD	252UK-1
333	TIEPIE ENGINEERING	351

7 DISK & OPTICAL DRIVES

80-82	ALPHATRONIX	157
84-85	AMERICAN MEGATRENDS	115
385-386	CORE INTERNATIONAL	208IS-1
111	CURTIS INC	298
124-125	EXABYTE CORPORATION	251
408	MICRO DESIGN INTERNATIONAL	176IS-4
268	MICRO SOLUTIONS COMP PROD	319
150-151	MICRONET TECHNOLOGY	203
521	NEC - MONITORS	74-75
174-175	PINNACLE MICRO	6-7
176	PIONEER COMMUNICATIONS	141
322	SIGEN	351
189	SONY CPCC	184A-H
253-254	STORAGE DEVICES INC	181
195	STORAGE DIMENSIONS	273
331	TRANTRON SYSTEMS LTD	351

8 DISKETTES/DUPLICATORS

493	SONY (N.A.)	205
214	VERBATIM CORPORATION	159

9 FAX BOARDS/MACHINES

370	COMPUTER TELECOMMUNICATIONS	240UK-2
460-461	KINGLI TECHNOLOGY, INC	340MW-2
468-469	KINGLI TECHNOLOGY, INC	340NE-6
440-441	PORA CORPORATION	184IS-12

10 GRAPHICS TABLETS/MICE/PEN INPUT

362-363	C.P. RESEARCH	352
122	DIGITAL VISION	164
197	SUMMAGRAPHICS CORP	259

11 KEYBOARDS

377-378	CHERRY MIKROSCHALTER GMBH	208IS-2-3
116-117	DATALUX CORPORATION	190
228-229	LEXMARK INTERNATIONAL	73

12 LAN HARDWARE

262-263	ADVANCED COMPUTER INT'L	340MW-3
487-488	ADVANCED COMPUTER INT'L	340SO-1
504-505	ADVANCED COMPUTER INT'L	340NE-2
506-507	ADVANCED COMPUTER INT'L	340PC-12
261	CYBEX CORPORATION	328
387	CYBEX CORPORATION (INT'L)	CIII
150-151	MICRONET TECHNOLOGY	203
421	MINICOM LTD	184IS-2
494-495	NETWORK EXPRESS	348
*	NORTHGATE COMP SYS	344
166-167	PC POWER & COOLING	55

13 LAPTOPS & NOTEBOOKS

372-373	ABC COMPUTER	292IS-1
287-288	ABC COMPUTER (USA) CORP	320
61-62	ADVANCED LOGIC RESEARCH	211
448-449	AUTO COMPUTER CO. LTD	184IS-11
92-93	BAY TECHNICAL ASSOC	54
241	COMPUPLYNE	26-27
428	DAEWOO	184IS-1
123	DOLCH COMPUTER SYSTEMS	79
282	DYNAMICSCAN	316-317
280-281	MICRO-INTERNATIONAL, INC	338
*	NORTHGATE COMP SYS	344
253-254	STORAGE DEVICES INC	181
204	TOSHIBA AMERICA INC	42-43
496	TOTE-A-LAP	345
73	ZEOS INTERNATIONAL	216-217

14 MAIL ORDER

294-295	AAEON	352
256-257	ADVANCED COMPUTER PROD	341
296	AMERICAN ADVANTECH	352

Category No.
Inquiry No.

Page No.

258	AMT INTERNATIONAL	346
248	ARES MICRO DEVELOPMENT	34-35
259	BULLDOG COMPUTER PROD	337
*	BYTE BUYER'S MART	176IDRC-3-4
278	CITITRONICS	318
241	COMPUPLYNE	26-27
260	COMPUTERLANE UNLIMITED	343
392-397	CYBER RESEARCH	326-327
96	DECISIONS	371
65	JAMECO ELECTRONICS	228-229
340NE-5	JDR MICRODEVICES	311
184IS-9	LOOM, INC	350
276	LODE STAR COMPUTER	308-309
280-281	MICRO-INTERNATIONAL, INC	338
266	NEVADA COMPUTER	330-331
186	S'NW ELECTRONICS	252

15 MEMORY/CHIPS/UPGRADES

262-263	ADVANCED COMPUTER INT'L	340MW-3
487-488	ADVANCED COMPUTER INT'L	340SO-1
504-505	ADVANCED COMPUTER INT'L	340NE-2
506-507	ADVANCED COMPUTER INT'L	340PC-12
83	ADVANCED MICRO DEVICES	10-11
98	CAPITAL EQUIPMENT CO	186
99	CAPITAL EQUIPMENT CO	187
112-113	CYRIX	152
364	DATAMAN LTD	252UK-3
264-265	FIRST SOURCE INT'L	332
132	HAUPPAUGE COMP WORKS	53
138-139	INTEGRATED INFO TECH	287
63	INTEL CORPORATION	222-223
65	JAMECO ELECTRONICS	228-229
510-511	KINGSTON TECHNOLOGY	215
335	MEMORY SUPERSTORE	352
342	SMARTMICRO TECHNOLOGIES	352
289-290	TRANSCEND INFORMATION INC	335
326	UPGRADES ETC	353
357	USA ELECTRONICS, INC	352
277	WORLDWIDE TECHNOLOGIES	342

16 MISCELLANEOUS HARDWARE

360-361	AVC	353
227	CREATIVE LABS INC	69
140	INTEGRAND RESEARCH	206
231-232	PROXIMA CORPORATION	241
71-72	RAINBOW TECHNOLOGIES	231
69-70	RAINBOW TECHNOLOGIES	212
279	SECURTECH COMPANY	347
413-414	SEKISUI CHEMICAL CO LTD	284IS-4
189	SONY CPCC	184A-H

17 MODEMS/MULTIPLEXORS

242	AT & T PARADYNE (N.A.)	99-101
262-263	ADVANCED COMPUTER INT'L	340MW-3
487-488	ADVANCED COMPUTER INT'L	340SO-1
504-505	ADVANCED COMPUTER INT'L	340NE-2
506-507	ADVANCED COMPUTER INT'L	340PC-12
109	COMPUTER FRIENDS	268
388-389	DATATRONICS TECHNOLOGY	292IS-2
464-467	MAGADATA	276IS-4
440-441	PORA CORPORATION	184IS-12
285	RALIN WHOLESALERS	312-313
234	SUPRA CORPORATION	175
239-240	ZYXEL USA	183

18 MONITORS & TERMINALS

457-458	ACER PERIPHERALS	184IS-15
500-501	CTX INTERNATIONAL INC	291
401	HANTAREX SPA	268IS-1
64	IO COMM	227
434-435	KUO FENG CORPORATION	184IS-17
235-236	MAG INNOVISION	37
156-157	NANAO USA CORP	178-179
66-67	OPTQUEST	213
411	PHILIPS MONITORS (INT'L)	92-93
189	SONY CPCC	184A-H
217-218	VIEWSONIC	245

19 MULTIMEDIA

225-226	ADDA	274
79	AITECH	258
97	CANON USA INC	112
227	CREATIVE LABS INC	69
500-501	CTX INTERNATIONAL INC	291
347	EMPIRE COMPUTECH	353
305	HIGH-RES TECHNOLOGIES	353
149	MATROX VIDEO PRODUCTS GROUP	284
291	MEGAMEDIA COMPUTER CORP	334
160	NEW MEDIA GRAPHICS CORP	290
479	PLUSTEK USA, INC	340PC-6
231-232	PROXIMA CORPORATION	241
285	RALIN WHOLESALERS	312-313
320	SILICON SHACK	353
202	TEKTRONIX	260
366	WESTPOINT CREATIVE	240UK-3
480-481	YUAN TECHNOLOGY INC	340PC-11

20 PRINTERS/PLOTTERS

262-263	ADVANCED COMPUTER INT'L	340MW-3
487-488	ADVANCED COMPUTER INT'L	340SO-1
504-505	ADVANCED COMPUTER INT'L	340NE-2

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want FREE information on the following products!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

Fill out this coupon carefully. Please Print.

Name _____

Title _____

Company _____

Address _____

City _____ Country _____ Code _____

Phone _____ Fax _____

A. What is your primary job function/principal area of responsibility? (Check one)

- ☐ MIS/DIP
☐ Programmer/Systems Analyst
☐ Administration/Management
☐ Sales/Marketing
☐ Engineer/Scientist
☐ Other

B. What is your level of management responsibility?

- ☐ Senior-level
☐ Middle-level
☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- ☐ Yes ☐ No

D. What operating systems are you currently using? (Check all that apply)

- ☐ PC/MS-DOS ☐ Unix
☐ DOS + Windows ☐ Mac OS
☐ OS/2 ☐ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- ☐ 1-25 ☐ 51-99
☐ 26-50 ☐ 100 or more

November 1992

90 96 99

Product Category Information Circle the numbers below for information on the entire category of products you're interested in.		Disks & Optical Drives	7	Multimedia	19	Educational	30	Shareware	42
		Diskettes/Duplicators	8	Printers/Plotters	20	Engineering/Scientific	31	Software Duplication	43
		Fax Boards/Machines	9	Programmable Hardware	21	Entertainment	32	Spreadsheets	44
		Graphics Tablets/Mice/		Scanners/OCR/Digitizers	22	Graphics	33	Unix	45
		Pen Input	10	Tape Drives	23	Macintosh	34	Utilities	46
Hardware		Keyboards	11	UPS	24	Mail Order	35	Windows	47
Accessories/Supplies	1	LAN Hardware	12	Software		Mathematical/Statistical	36	Word Processing	48
Add-in Boards	2	Laptops & Notebooks	13	Business	25	Miscellaneous Software	37	General	
Bar Coding	3	Mail Order	14	CAD/CAM	26	On-Line Services	38	Books/Publications	49
Communications/Networking	4	Memory/Chips/Upgrades	15	Communications/Networking	27	Operating Systems	39	Recruitment	50
Computer Systems	5	Miscellaneous Hardware	16	Data Acquisition	28	Programming Languages/		Miscellaneous	51
Data Acquisition	6	Modems/Multiplexors	17	Database	29	Tools	40		
		Monitors & Terminals	18			Security	41		

Inquiry Numbers 52-233

52	78	104	130	156	182	208
53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
58	84	110	136	162	188	214
59	85	111	137	163	189	215
60	86	112	138	164	190	216
61	87	113	139	165	191	217
62	88	114	140	166	192	218
63	89	115	141	167	193	219
64	90	116	142	168	194	220
65	91	117	143	169	195	221
66	92	118	144	170	196	222
67	93	119	145	171	197	223
68	94	120	146	172	198	224
69	95	121	147	173	199	225
70	96	122	148	174	200	226
71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

Inquiry Numbers 409-590

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
414	440	466	492	518	544	570
415	441	467	493	519	545	571
416	442	468	494	520	546	572
417	443	469	495	521	547	573
418	444	470	496	522	548	574
419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
422	448	474	500	526	552	578
423	449	475	501	527	553	579
424	450	476	502	528	554	580
425	451	477	503	529	555	581
426	452	478	504	530	556	582
427	453	479	505	531	557	583
428	454	480	506	532	558	584
429	455	481	507	533	559	585
430	456	482	508	534	560	586
431	457	483	509	535	561	587
432	458	484	510	536	562	588
433	459	485	511	537	563	589
434	460	486	512	538	564	590

Inquiry Numbers 766-947

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

Inquiry Numbers 1123-1304

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
1132	1158	1184	1210	1236	1262	1288
1133	1159	1185	1211	1237	1263	1289
1134	1160	1186	1212	1238	1264	1290
1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

Inquiry Numbers 234-408

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
240	265	290	315	340	365	390
241	266	291	316	341	366	391
242	267	292	317	342	367	392
243	268	293	318	343	368	393
244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
247	272	297	322	347	372	397
248	273	298	323	348	373	398
249	274	299	324	349	374	399
250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
253	278	303	328	353	378	403
254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

Inquiry Numbers 591-765

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

Inquiry Numbers 948-1122

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
960	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120
971	996	1021	1046	1071	1096	1121
972	997	1022	1047	1072	1097	1122

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

TNT MAILFAST

FRG/BOS/700252/MO1

P.O. Box 66

Hounslow

TW5 9RT

England

PLACE
POSTAGE
HERE



BYTE

YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want **FREE** information on the following products!

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to
1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

Fill out this coupon carefully. Please Print.

Name

Title

Company

Address

City

Country

Code

Phone

Fax

A. What is your primary job function/principal area of responsibility? (Check one)

- 1 ☐ MIS/DIP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

- 7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- 10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply)

- 12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ Unix
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- 18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

November 1992

90 96 99

Product Category Information

Circle the numbers below for information on the entire category of products you're interested in.

Hardware

- Accessories/Supplies 1
Add-in Boards 2
Bar Coding 3
Communications/Networking 4
Computer Systems 5
Data Acquisition 6

- Disks & Optical Drives 7
Diskettes/Duplicators 8
Fax Boards/Machines 9
Graphics Tablets/Mice/ Pen Input 10
Keyboards 11
LAN Hardware 12
Laptops & Notebooks 13
Mail Order 14
Memory/Chips/Upgrades 15
Miscellaneous Hardware 16
Modems/Multiplexors 17
Monitors & Terminals 18

- Multimedia 19
Printers/Plotters 20
Programmable Hardware 21
Scanners/OCR/Digitizers 22
Tape Drives 23
UPS 24
Software Business 25
CAD/CAM 26
Communications/Networking 27
Data Acquisition 28
Database 29

- Educational 30
Engineering/Scientific 31
Entertainment 32
Graphics 33
Macintosh 34
Mail Order 35
Mathematical/Statistical Miscellaneous Software 36
On-Line Services 37
Operating Systems 38
Programming Languages/Tools 39
Security 40

- Shareware 41
Software Duplication 42
Spreadsheets 43
Unix 44
Utilities 45
Windows 46
Word Processing 47
General 48
Books/Publications 49
Recruitment 50
Miscellaneous 51

Inquiry Numbers 52-233

52 78 104 130 156 182 208
53 79 105 131 157 183 209
54 80 106 132 158 184 210
55 81 107 133 159 185 211
56 82 108 134 160 186 212
57 83 109 135 161 187 213
58 84 110 136 162 188 214
59 85 111 137 163 189 215
60 86 112 138 164 190 216
61 87 113 139 165 191 217
62 88 114 140 166 192 218
63 89 115 141 167 193 219
64 90 116 142 168 194 220
65 91 117 143 169 195 221
66 92 118 144 170 196 222
67 93 119 145 171 197 223
68 94 120 146 172 198 224
69 95 121 147 173 199 225
70 96 122 148 174 200 226
71 97 123 149 175 201 227
72 98 124 150 176 202 228
73 99 125 151 177 203 229
74 100 126 152 178 204 230
75 101 127 153 179 205 231
76 102 128 154 180 206 232
77 103 129 155 181 207 233

Inquiry Numbers 409-590

409 435 461 487 513 539 565
410 436 462 488 514 540 566
411 437 463 489 515 541 567
412 438 464 490 516 542 568
413 439 465 491 517 543 569
414 440 466 492 518 544 570
415 441 467 493 519 545 571
416 442 468 494 520 546 572
417 443 469 495 521 547 573
418 444 470 496 522 548 574
419 445 471 497 523 549 575
420 446 472 498 524 550 576
421 447 473 499 525 551 577
422 448 474 500 526 552 578
423 449 475 501 527 553 579
424 450 476 502 528 554 580
425 451 477 503 529 555 581
426 452 478 504 530 556 582
427 453 479 505 531 557 583
428 454 480 506 532 558 584
429 455 481 507 533 559 585
430 456 482 508 534 560 586
431 457 483 509 535 561 587
432 458 484 510 536 562 588
433 459 485 511 537 563 589
434 460 486 512 538 564 590

Inquiry Numbers 766-947

766 792 818 844 870 896 922
767 793 819 845 871 897 923
768 794 820 846 872 898 924
769 795 821 847 873 899 925
770 796 822 848 874 900 926
771 797 823 849 875 901 927
772 798 824 850 876 902 928
773 799 825 851 877 903 929
774 800 826 852 878 904 930
775 801 827 853 879 905 931
776 802 828 854 880 906 932
777 803 829 855 881 907 933
778 804 830 856 882 908 934
779 805 831 857 883 909 935
780 806 832 858 884 910 936
781 807 833 859 885 911 937
782 808 834 860 886 912 938
783 809 835 861 887 913 939
784 810 836 862 888 914 940
785 811 837 863 889 915 941
786 812 838 864 890 916 942
787 813 839 865 891 917 943
788 814 840 866 892 918 944
789 815 841 867 893 919 945
790 816 842 868 894 920 946
791 817 843 869 895 921 947

Inquiry Numbers 1123-1304

1123 1149 1175 1201 1227 1253 1279
1124 1150 1176 1202 1228 1254 1280
1125 1151 1177 1203 1229 1255 1281
1126 1152 1178 1204 1230 1256 1282
1127 1153 1179 1205 1231 1257 1283
1128 1154 1180 1206 1232 1258 1284
1129 1155 1181 1207 1233 1259 1285
1130 1156 1182 1208 1234 1260 1286
1131 1157 1183 1209 1235 1261 1287
1132 1158 1184 1210 1236 1262 1288
1133 1159 1185 1211 1237 1263 1289
1134 1160 1186 1212 1238 1264 1290
1135 1161 1187 1213 1239 1265 1291
1136 1162 1188 1214 1240 1266 1292
1137 1163 1189 1215 1241 1267 1293
1138 1164 1190 1216 1242 1268 1294
1139 1165 1191 1217 1243 1269 1295
1140 1166 1192 1218 1244 1270 1296
1141 1167 1193 1219 1245 1271 1297
1142 1168 1194 1220 1246 1272 1298
1143 1169 1195 1221 1247 1273 1299
1144 1170 1196 1222 1248 1274 1300
1145 1171 1197 1223 1249 1275 1301
1146 1172 1198 1224 1250 1276 1302
1147 1173 1199 1225 1251 1277 1303
1148 1174 1200 1226 1252 1278 1304

Inquiry Numbers 234-408

234 259 284 309 334 359 384
235 260 285 310 335 360 385
236 261 286 311 336 361 386
237 262 287 312 337 362 387
238 263 288 313 338 363 388
239 264 289 314 339 364 389
240 265 290 315 340 365 390
241 266 291 316 341 366 391
242 267 292 317 342 367 392
243 268 293 318 343 368 393
244 269 294 319 344 369 394
245 270 295 320 345 370 395
246 271 296 321 346 371 396
247 272 297 322 347 372 397
248 273 298 323 348 373 398
249 274 299 324 349 374 399
250 275 300 325 350 375 400
251 276 301 326 351 376 401
252 277 302 327 352 377 402
253 278 303 328 353 378 403
254 279 304 329 354 379 404
255 280 305 330 355 380 405
256 281 306 331 356 381 406
257 282 307 332 357 382 407
258 283 308 333 358 383 408

Inquiry Numbers 591-765

591 616 641 666 691 716 741
592 617 642 667 692 717 742
593 618 643 668 693 718 743
594 619 644 669 694 719 744
595 620 645 670 695 720 745
596 621 646 671 696 721 746
597 622 647 672 697 722 747
598 623 648 673 698 723 748
599 624 649 674 699 724 749
600 625 650 675 700 725 750
601 626 651 676 701 726 751
602 627 652 677 702 727 752
603 628 653 678 703 728 753
604 629 654 679 704 729 754
605 630 655 680 705 730 755
606 631 656 681 706 731 756
607 632 657 682 707 732 757
608 633 658 683 708 733 758
609 634 659 684 709 734 759
610 635 660 685 710 735 760
611 636 661 686 711 736 761
612 637 662 687 712 737 762
613 638 663 688 713 738 763
614 639 664 689 714 739 764
615 640 665 690 715 740 765

Inquiry Numbers 948-1122

948 973 998 1023 1048 1073 1098
949 974 999 1024 1049 1074 1099
950 975 1000 1025 1050 1075 1100
951 976 1001 1026 1051 1076 1101
952 977 1002 1027 1052 1077 1102
953 978 1003 1028 1053 1078 1103
954 979 1004 1029 1054 1079 1104
955 980 1005 1030 1055 1080 1105
956 981 1006 1031 1056 1081 1106
957 982 1007 1032 1057 1082 1107
958 983 1008 1033 1058 1083 1108
959 984 1009 1034 1059 1084 1109
960 985 1010 1035 1060 1085 1110
961 986 1011 1036 1061 1086 1111
962 987 1012 1037 1062 1087 1112
963 988 1013 1038 1063 1088 1113
964 989 1014 1039 1064 1089 1114
965 990 1015 1040 1065 1090 1115
966 991 1016 1041 1066 1091 1116
967 992 1017 1042 1067 1092 1117
968 993 1018 1043 1068 1093 1118
969 994 1019 1044 1069 1094 1119
970 995 1020 1045 1070 1095 1120
971 996 1021 1046 1071 1096 1121
972 997 1022 1047 1072 1097 1122

Inquiry Numbers 1305-1479

1305 1330 1355 1380 1405 1430 1455
1306 1331 1356 1381 1406 1431 1456
1307 1332 1357 1382 1407 1432 1457
1308 1333 1358 1383 1408 1433 1458
1309 1334 1359 1384 1409 1434 1459
1310 1335 1360 1385 1410 1435 1460
1311 1336 1361 1386 1411 1436 1461
1312 1337 1362 1387 1412 1437 1462
1313 1338 1363 1388 1413 1438 1463
1314 1339 1364 1389 1414 1439 1464
1315 1340 1365 1390 1415 1440 1465
1316 1341 1366 1391 1416 1441 1466
1317 1342 1367 1392 1417 1442 1467
1318 1343 1368 1393 1418 1443 1468
1319 1344 1369 1394 1419 1444 1469
1320 1345 1370 1395 1420 1445 1470
1321 1346 1371 1396 1421 1446 1471
1322 1347 1372 1397 1422 1447 1472
1323 1348 1373 1398 1423 1448 1473
1324 1349 1374 1399 1424 1449 1474
1325 1350 1375 1400 1425 1450 1475
1326 1351 1376 1401 1426 1451 1476
1327 1352 1377 1402 1427 1452 1477
1328 1353 1378 1403 1428 1453 1478
1329 1354 1379 1404 1429 1454 1479



YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!

BYTE

TNT MAILFAST

FRG/BOS/700252/MO1

P.O. Box 66

Hounslow

TW5 9RT

England

PLACE
POSTAGE
HERE



BYTE

YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For **FREE** product information from individual advertisers, circle the corresponding inquiry numbers on your Direct Link Card!

To receive information for an entire product category, circle the category number on your Direct Link Card!

Category No. Inquiry No.		Page No.	Category No. Inquiry No.		Page No.	Category No. Inquiry No.		Page No.
506-507	ADVANCED COMPUTER INT'L	340PC-12	224	ZYLAB / DIVISION OF IDI	288	154	MIX SOFTWARE	300
90	ASP COMPUTER PRODUCTS	234				423	ON TIME MKT / KARSTEN PETERSEN	276IS-2
399	BUFFALO PRODUCTS	315	30	EDUCATIONAL		170-171	PERISCOPE COMPANY, THE	176
249	CANON INFORMATION SYSTEMS	60-61	76-77	ABACUS SOFTWARE	143	173	PHAR LAP SOFTWARE INC	47
136	IBM / LEXMARK	84-85	*	AME INSTIT FOR COMP SCIENCES	356	*	PROGRAMMER'S SHOP	124-126
409	MINOLTA GMBH (INT'L)	99	31	ENGINEERING/SCIENTIFIC		69-70	RAINBOW TECHNOLOGIES	212
159	NEC - PRINTERS	48-49				71-72	RAINBOW TECHNOLOGIES	231
*	OUTPUT TECHNOLOGY CO	25	87-88	ARC SOFTWARE	268	223	SYMANTEC	137
*	PACIFIC DATA PRODUCTS	243	508-509	DIAGSOFT INC	298	211	TURBOPOWER SOFTWARE	282
285	RALIN WHOLESALE	312-313	340	GRAMMAR ENGINE, INC	356	219	WATCOM PRODUCTS INC	29
202	TEKTRONIX	260	198-199	LANDMARK RESEARCH INT'L CORP	151	220	WATCOM PRODUCTS INC	91
203	TEXAS INSTRUMENTS	267	147	MATHSOFT INC	263			
21	PROGRAMMABLE HARDWARE		148	MATHSOFT INC	263	41	SECURITY	
92-93	BAY TECHNICAL ASSOC	54	423	ON TIME MKT / KARSTEN PETERSEN	276IS-2	78	ALADDIN KNOWLEDGE SYSTEMS	116
364	DATAMAN LTD	252UK-3	190	SPECTRUM SOFTWARE (N.A.)	277	374	ALADDIN KNOWLEDGE SYSTEMS	268IS-2
351-352	DAVISON-WORTH CORPORATION	353	191	SPSS INC	147	473	ALADDIN KNOWLEDGE SYSTEMS	340PC-11
307	IO TECH	354	192-193	STATSOFT	237	519	ALADDIN KNOWLEDGE SYSTEMS	340PC-10
308	IO TECH	354	200-201	SYSTAT INC	123	255	DALLAS SEMICONDUCTOR	103
312	LINK COMPUTER GRAPHICS	354	327	VISTA MICROSYSTEMS	357	390	FAST ELECTRONIC GMBH	184IS-3
338	METALINK CORPORATION	354	32	ENTERTAINMENT		129-130	GLENCO ENGINEERING	197
324-325	TRIBAL MICROSYSTEMS	354	292-293	ACCESS SOFTWARE	346-347	69-70	RAINBOW TECHNOLOGIES	212
329	XELTEK	354	267	MICROPROSE SOFTWARE	329	71-72	RAINBOW TECHNOLOGIES	231
330	Z-WORLD ENGINEERING	354	366	WESTPOINT CREATIVE	240UK-3	187-188	SOFTWARE SECURITY INC	64
22	SCANNERS/OCR/DIGITIZERS		33	GRAPHICS		245-247	VILLA CRESPO SOFTWARE LTD	165
370	COMPUTER TELECOMMUNICATIONS	240UK-2	424	ARABIC PUBLISHER	284IS-2	42	SHAREWARE	
231-232	PROXIMA CORPORATION	241	110	COREL SOFTWARE	44	*	REASONABLE SOLUTIONS	176IDRC-1-2
23	TAPE DRIVES		500-501	CTX INTERNATIONAL INC	291	44	SPREADSHEETS	
84-85	AMERICAN MEGATRENDS	115	*	FRAME TECHNOLOGY	168A-B	105	COMPUTER ASSOCIATES	33
100-101	COLORADO MEMORY SYSTEMS	63	502	MICROGRAFX	169	107	COMPUTER ASSOCIATES	71
385-386	CORE INTERNATIONAL	208IS-1	156-157	NANAO USA CORP	289	45	UNIX	
311	LAGUNA DATA SYSTEMS	355	334	OSCS	358	368	CORPORATE HI TECH SERVICES	252UK-2
336	NOVASTOR CORP	355	*	PACIFIC DATA PRODUCTS	243	135	HUMMINGBIRD COMMUNICATIONS	275
315	OVERLAND DATA INC	355	371	R.E.M.	240UK-4	141-143	QUIN (N.A.)	92-93
74-75	PARALLEL PERIPHERALS	235	202	TEKTRONIX	260	*	MARK WILLIAMS CO	97
318	QUALSTAR CORP	355	34	MACINTOSH		155	MKS / MORTICE KERN SYSTEMS	248
24	UPS		141-143	INTERGRAPH (N.A.)	92-93	494-495	NETWORK EXPRESS	348
391	BEST POWER TECHNOLOGIES	321-324	460-461	KINGLI TECHNOLOGY, INC	340MW-2	178	ONX / QUANTUM SOFTWARE SYSTEMS	283
*	BEST POWER TECHNOLOGIES	324A-B	468-469	KINGLI TECHNOLOGY, INC	340NE-6	426	STRUCTURED SOFTWARE SOLUTIONS	268IS-2
164	MINUTEMAN	113	200-201	SYSTAT INC	123	215	VERSASOFT	96
166-167	PC POWER & COOLING	55	35	MAIL ORDER		46	UTILITIES	
455-456	SINETEC TECHNOLOGY	184IST-2	259	BULLDOG COMPUTER PRODUCTS	337	379-380	CLARION SOFTWARE	184IS-4
207-208	TRIPP LITE	122	383	COMPU SAVE INTERNATIONAL	208IS-4	198-199	LANDMARK RESEARCH INT'L CORP	151
SOFTWARE			384	COMPUTER QUICK	62	334	OSCS	358
25	BUSINESS		400	GREY MATTER LTD	268IS-3	177	PKWARE INC	168
427	ITALIAN SOFTWARE AGENCY (INT'L)	277	430	OMNI PLUS	276IS-4	194	STORAGE DIMENSIONS	264
359	MP1 MARKETING	355	146	PROGRAMMER'S PARADISE	65-67	205-206	TOUCHSTONE SOFTWARE	184
165	PATTON & PATTON	170	*	PROGRAMMER'S SHOP	124-126	*	VERMONT CREATIVE SOFTWARE	23
172	PERSONAL TEX	292	186	S'NW ELECTRONICS	252	47	WINDOWS	
412	SZKI RECOGNITA CORP	276IS-3	356	SOFTLINE CORP	176IS-1	358	DIGITAL SOUP INC	358
26	CAD/CAM		36	MATHEMATICAL/STATISTICAL		133	HEWLETT PACKARD	30-31
86	AMERICAN SMALL BUSINESS COMP	271	319	SAS INSTITUTE INC	357	134	HEWLETT PACKARD	88-89
91	AUTODESK INC	171	192-193	STATSOFT	237	135	HUMMINGBIRD COMMUNICATIONS	275
341	CADSOFT COMPUTER, INC	355	37	MISCELLANEOUS SOFTWARE		367	ICONOGRAPHIC SYSTEMS	240UK-2
522-523	EVOLUTION COMPUTING	340	508-509	DIAGSOFT INC	298	144	KEA SYSTEMS LTD	114
141-143	INTERGRAPH	92-93	423	ON TIME MKT / KARSTEN PETERSEN	276IS-2	313	MICROSTAR LABORATORIES	356
371	R.E.M.	240UK-4	38	ON-LINE SERVICES		156-157	NANAO USA CORP	178-179
328	WINTTEK CORP	355	*	AMERICA ONLINE INCORPORATED	176A-B	230	NETWORK COMPUTING DEVICES	201
27	COMMUNICATIONS/NETWORKING		450	BIX	371	494-495	NETWORK EXPRESS	348
237	CASTELLE CORP	41	104	COMPU SERVE	152A-B	369	QUIN SYSTEMS LTD	252UK-1
368	CORPORATE HI TECH SERVICES	252UK-2	499	COMPU SERVE	153	212-213	VENTURA SOFTWARE INC	247
118-119	DCA	59	39	OPERATING SYSTEMS		245-247	VILLA CRESPO SOFTWARE LTD	165
298	DIVERSIFIED COMPUTER	355	368	CORPORATE HI TECH SERVICES	252UK-2	221-222	XVT SOFTWARE INC	19
421	MINICOM LTD	184IS-2	134	HEWLETT PACKARD	30-31	224	ZYLAB / DIVISION OF IDI	288
494-495	NETWORK EXPRESS	348	137	IBM / OS/2	56-57	48	WORD PROCESSING/DTF	
334	OSCS	358	*	MARK WILLIAMS CO	97	301	GLOBALINK INC	358
412	SZKI RECOGNITA CORP	276IS-3	515	QUARTERDECK OFFICE SYSTEMS	144QD-1-32	410	OXFORD ELECTRONIC PUBLISHING	276IS-4
417	TRITON TECHNOLOGIES	176IS-2	*	QUARTERDECK OFFICE SYSTEMS	144QD-33-34	212-213	VENTURA SOFTWARE INC	247
420	WALKER, RICHER & QUINN (INT'L)	205	40	PROGRAMMING LANGUAGES/TOOLS		224	ZYLAB / DIVISION OF IDI	288
28	DATA ACQUISITION		196	APL * PLUS / MANUIGISTICS	105	49	BOOKS/PUBLICATIONS	
339	DAVIS INSTRUMENTS	356	*	BINARY TECHNOLOGY INC	358	*	C++ REPORT	176IDRC-3-4
313	MICROSTAR LABORATORIES	356	512	BLINK INC	305	355	HARPER COLLINS	349
158	NATIONAL INSTRUMENTS	9	94-95	BORLAND INTERNATIONAL	13-17-83	*	JNL OF OBJ ORIENT PROGRAMMING	176IDRC-1-2
314	NATIONAL INSTRUMENTS	356	375-376	BORLAND INTERNATIONAL	CIV	152	MICROSOFT PRESS INC	110
*	NATIONAL INSTRUMENTS	176IDRC-1-2	243-244	CASE DESIGN INTERNATIONAL	191	163	OSBORNE MCGRAW-HILL	106-108
369	QUIN SYSTEMS LTD	252UK-1	114-115	DATA ACCESS CORP	166	*	UNIXWORLD	284A-B
333	TIEPIE ENGINEERING	351	472	DYALOG API	340NE-3	*	UNIXWORLD	285
29	DATABASE		127-128	FTP SOFTWARE (N.A.)	62	51	MISCELLANEOUS	
108	COMPUTER ASSOCIATES	80-81	303	GREENLEAF SOFTWARE	357	*	BYTE CARD DECK	176IDRC-3-4
106	COMPUTER ASSOCIATES	138	400	GREY MATTER LTD	268IS-3	*	BYTE REPRINTS	292
297	COMPUTERWISE	356	402-403	ISLAND SYSTEMS (INT'L)	292IS-2	*	BYTE SUB MESSAGE	270
405	MAGIC / MSE (INT'L)	176IS-3	346	IVERSON SOFTWARE, INC	358	433	C.E.T.R.A.	184IST-7
180	RAIMA CORP	95	145	LAHEY COMPUTER SYSTEMS	252	476	DEXPO / MILLER FREEMAN, INC	340PC-4
185	SEQUITER SOFTWARE INC	255	404	LOGIC PROGRAMMING ASSOCIATES	284IS-2	131	GRAFPOINT INC	274
212-213	VENTURA SOFTWARE INC	247	405	MAGIC / MSE (INT'L)	176IS-3	*	UNICODE CONSORTIUM	276IS-2

EDITORIAL INDEX

For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on Your Direct Link Card. Each page number refers to the first page of the article or section in which the company name appears.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
A				K			
1150	Accolade 109	1334	DEC 128, 192, 293	1314	Kaetron Software 98	1341	Radius 192
	Acorn Computers 40		Deico Electronics 45	1312	Kensington Marketing Systems 98	1322	Research Systems 102
	Action Consulting 185		Dell Computer 32, 128, 209, 372	1306	Knowledge Garden 94	S	
1151	Activision 109	1226	DeltaPoint 256	L			
1231	Adobe Systems 238, 299	1115	DFI-USA 209		Lernout & Hauspie Products 185	1010	Seaport Imaging 190
1105	Advanced Logic Research 128, 209		Digicom Systems 185		Liant Software 94		Sega 40
1331	Aldus 58, 192, 249		Digidesign 167	1307	Lodestar Computer 209	1006, 1230	Shiva 190, 269
	Analog Devices 177	1293	Digital Vision 139		Logitech 139		SID 45
1003	Antex Electronics 190		Digitizer Products 82	1120	Lotus Development 45, 167		Siemens Nixdorf 128
1329	Apple Computer 128, 167, 192, 238, 293	1011	Dillon, Reed 128			1342	Silicon Graphics 192
	Apricot 128	1233	Dipix Technologies 190			1005	Singular Solutions 190
1007	Ariel 167, 190	1008	Diva 238	M			
1279	Arkenstone 77	1116	DSP Technology 190	1283	Mac Connect 78		Softool 28
1292	Armchair General 82		Duracom Computer Systems 209	1298	MacNet 86		Sony 139, 303
1082	Artisoft 58	E		1273	Mainstream Computers 76		Southern Bell 278
1332	Ashlar 192		Eastman Kodak 139	1159	MasterSoft 109		SparcLite 293
	Asina Computer Systems 128	1004	Echo Speech 190	1234	Matemática 238		Specom 185
	AST Research 128	1286	Edge Technology 78	1009, 1225, 1339	Matrox Electronic Systems 190, 192, 261	1287	Star Gate Technologies 78
1232	AT&T 167, 177, 238, 253, 261, 299		Eighteen Eight Laboratories 190	1278	Maxi Switch 77	1295	Starlight Networks 86
	ATI Technologies 28	1282	Envisio 78		Metaresearch 167	1285	STB Systems 78
1311	Atlas Business Solutions 98	1117	Everex Systems 128, 209	1227	Microcom 265	1281	Summagraphics 77
1106	Atlas Industries 209	1324	Evergreen Technologies 104	1149	MicroProse Software 109	1343	Sun Microsystems 32, 177, 192, 293
1274	Aurum Computer 76	F		1081, 1083, 1157	Microsoft 40, 45, 52, 62, 109, 167, 249, 253, 301, 303		SunPro 32
1330	Autodesk 192		Fácil Informática 45	1276	Microtec 45		Symantec 36
1326	Avid Technology 104	1335	Frame Technology 192	1229	Microtech International 77	1280	Syntest 77
1107	Axik Computer 209		Free Software Foundation 299	1289	Microtest 269	1319	Systat 102
B					Mind Path Technologies 82	T	
	Bell Labs 139	1118, 1147	Gateway 2000 109, 128, 209	1277	Motorola 167, 177, 293	1126	Tandy 40, 128, 209
1300	Best Data Products 90		GEC Plessey 293	1271		1127	Tangent Computer 76, 209
1108	Bi-Link Computer 209		Giga Operations 167				Texas Instruments 177
1221	Borland International 36, 45, 167, 253, 45	G		1148	Nanoo U.S.A. 109	1277	Texel America 77
			Hayes Microcomputer Products 167	1121, 1152	Nascom Computer 128		3-D Visions 256
C					NEC Technologies 40, 109, 209		Toshiba 50
1301	Cabletron Systems 90		Headland 28	1340	NeoConcepts 128	1313	TreeAge Software 98
	Canon 139	1336	Hewlett-Packard 128, 192		Next 167, 192		Trident 28
1345	Castelle 90	H			Nikon 139	1318	TriMetrix 102
1299	Cayman Systems 86		Image and Signal Processing 190		Nintendo 40	1128	Tri-Star Computer 209
	Chips & Technologies 36, 128	1080, 1154, 1337	IBM 28, 45, 50, 109, 145, 177, 192, 278	1122	Northgate Computer Systems 209		Tseng Labs 28
	Claris 58	1001	Image and Signal Processing 190		Novell 265		Tuxon Software Development 45
1291	Clary 82		Informix 256	N			
1302	Codenoll Technology 90	1119	Insight Distribution Network 209	1076	Okidata 68	U	
1109	Comex Computer 209	1290	Integrated Technology 82	1002	Olsson Engineering 190	1129	Uniq Tech 209
	Commodore Business Machines 40, 192	1156	Intel 32, 109, 293	1178	Optique 68	V	
1110, 1228, 1333	Compaq Computer 32, 45, 128, 192, 209, 249, 372	1304	Intellicom 90	O			
1111	CompuAdd 128, 209	1305	Interactive Software Engineering 94	1077	Olson Engineering 190	1344	ViewSonic 192
	Compucenter Informática 45	1338	Interleaf 192	1123	Packard Bell 209		VLSI Technology 293
	CompuServe 278	1079	International Computers International Meta Systems 36	1153, 1296	Palindrome 86, 109	W	
1112	CompuTrend Systems 209		Intersecting Concepts 303	1308	Pen Pal Associates 94		Weitek 177
1146	Corel Systems 109	1077	Intuit 68		Philips 40, 261		Western Digital 28
	Creative Labs 185	1325	Island Graphics 104	1075	Phoenix Technologies 128	1160	Wild West 45
1155	Crescent Software 109		Itautec 45	1288	PI Systems 68		Witch Systems AG 68
D				1124	Planmar Marketing 82		WordPerfect 36, 45, 167
1113	Daly Computers 209			1297	Polywell Computers 209	1130	Wyse Technology 128, 209
1158	Dariana Technology Group 109				Puzzle Systems 86	X	
	Datapro Information Services Group 28			1125	QSI 209		Xerox 145
							Xing Technology 185
						Z	
							Zenith Data Systems 128
							Zenith Electronics 40
							Zeos International 76
							ZIM 45
							Z-Nix 82
							Z-World Engineering 78

This Application Uses Over 100 Gigabytes of Memory!

BIX is the online service for people who know computing – it's the collective computing power of thousands of hardware and software engineers, systems designers, independent consultants, technology buffs, and computer industry celebrities. With BIX and the people you'll meet online, you'll have access to literally gigabytes of information, software, source code, news reports, and advice. And BIX now offers an optional access program that lets you take advantage of Windows™ while you're online.*

BIX is a Great Deal

Subscribe to BIX for only \$13 per month. Connect to BIX locally via Tymnet for only \$3 per hour in the evening and on weekends. Daytime rates are \$9 per hour. Higher connect rates apply for access outside the mainland US.

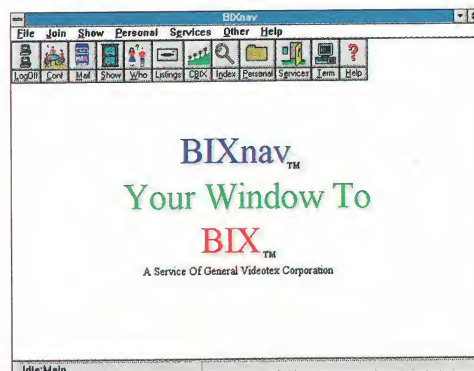
Join BIX Now!

Using any communications program:

- Dial by modem: 1-800-695-4882
- At "login" enter **bix**
- At "Name?" enter **bix.byte**

Further details and complete rate information will be provided during the toll-free registration.

Questions? Call 1-800-695-4775 (voice)



*Optional access program — just \$9.95!

- Get quick answers to tough coding questions
- Interact with top developers
- Download source code, utilities, & other programs
- Send & receive e-mail with binary attachments
- Chat with other BIX members in real time
- Track industry trends and announcements

Money-Back Guarantee: If for any reason you aren't happy with BIX, simply cancel your account and request a refund of your first monthly fee.

Windows is a trademark of Microsoft Corporation.
BIX is a service of General Videotex Corporation
1030 Massachusetts Avenue, Cambridge, MA 02138. 617-491-3342



STOP BIT

ESTHER DYSON

ARTIFICIAL LIFE AND NATURAL MARKETS

A nascent technology could legitimize capitalism in the former Soviet Union

Artificial life is a hot topic right now for computer scientists, biologists, and philosophers. But it may hold special meaning for the new entrepreneurs of Central Europe and the former Soviet Union by providing a respectable scientific model for the behavior of seemingly chaotic competitive markets. In a world where capitalist economics is still suspect, artificial life makes it clear that competition is a creative force, not a destructive one.

The basic idea behind artificial life, or *ALife*, is to build electronic "creatures" that reproduce—but imperfectly. Sometimes there are slight changes between the original and its children; sometimes by combining features of two original creatures you can produce a best-of-both-sides (or worst-of-both-sides) copy. If you select the best of each successive generation as the starting point for the next generation, you'll see something awesome: evolution at a time scale humans can comprehend.

One of the most exciting experiments along these lines is *Tierra*, created by Tom Ray, now at the Santa Fe Institute for complex adaptive systems. Ray created a single electronic creature that reproduced itself, with slight mutations. Soon these creatures had filled up available memory, and imperfect copies started to do strange things—use each other's code, get more efficient at reproducing, and so on. These creatures were parasites, and they became new species competing for resources.

ALife gives biologists and computer scientists a way to experiment that isn't possible in the "real" world. Traditional experiments usually take years to create and test a generation so that the best ones can be selected for the next round. Most biologists have to work with incomplete, hard-to-assess fossil records instead of tidy, well-organized interactive computer graphics, where you can trace the exact progress of generations.

The *ALife* experiments illustrate the awesomely creative power of competition. Creatures evolve best when they coevolve, when one species spurs another to evolve, exploiting its weaknesses and enhancing its strengths. When different species compete, they find niches and evolve into specialists at competing with one another or cooperating with other species.

As it happens, you can see this same principle work in markets. I divide my time between places such as Silicon

Valley and the emerging computer markets of Eastern Europe. Over and over, I see parallels between market processes and evolutionary processes, as illustrated by *ALife*. The major difference had been time scale, but now simulations let us look at both processes in real time.

In Eastern Europe, I can follow the stumbling, awkward process of market creation. The emergence of healthy competition is not automatic. The untrained notion of competition is that one side wins and the other loses. But as *ALife* illustrates, competition is a much more complex, self-organizing tool.

Slowly, the factors that made one side win get strengthened, while those that made the other side lose diminish. Competition fosters healthy diversity. Second-place finishers find other races to run, emphasizing different subsets of features. To compete successfully with Compaq, Dell didn't just do the same things better; it tried something different. The mathematics of how this happens are complex and can be observed in *ALife* simulations.

There's little coevolution in the new Russian markets, partly because competitors do not know enough about each other. Vendors don't have to compare their products to those of other vendors because everything is in such short supply. That will change.

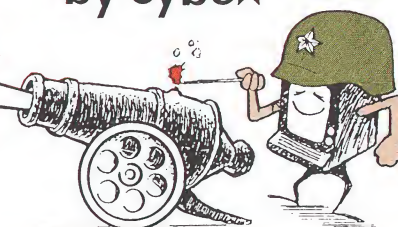
As *ALife* shows, the way to evolve is by defining yourself against the other guy, by specializing. The market isn't only about sellers talking to buyers, who determine fitness; it is also about sellers talking to each other, so that they can find their proper specialization.

The former Soviets have been trained to think of markets as wicked and dirty—and, indeed, most of the markets they've seen so far fit this description. The Communist model depicted a cleanly run, scientific world where goods were produced and allocated according to just, scientific principles, and where prices reflected costs of production. But prices work better when they reflect customer demand—or *fitness* in evolutionary terms. Prices do not just allocate scarce goods; they influence design and investment in the production of future goods. By clarifying the scientific principles behind markets and market pricing, artificial life may help to make them respectable, even in the eyes of former Communists. ■

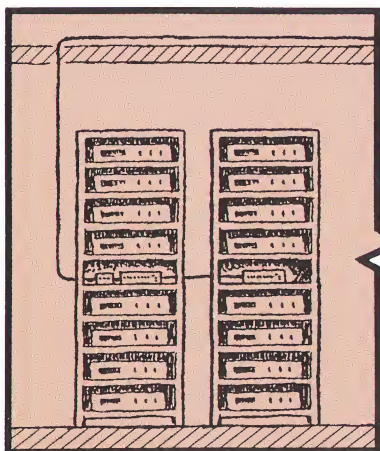
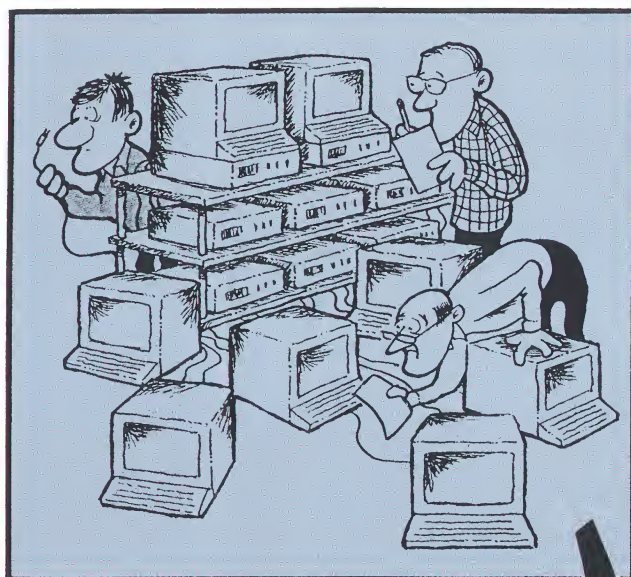
Esther Dyson is editor of Release 1.0, a newsletter that discusses exotic software, and of Rel-EAST, a newsletter about emerging computer markets in Central and Eastern Europe. You can reach her on BIX c/o "editors" or by MCI Mail at 511-3763.

CONTROL UP TO **96** PC FILE SERVERS WITH **1** KEYBOARD AND MONITOR USING... **COMMANDER**

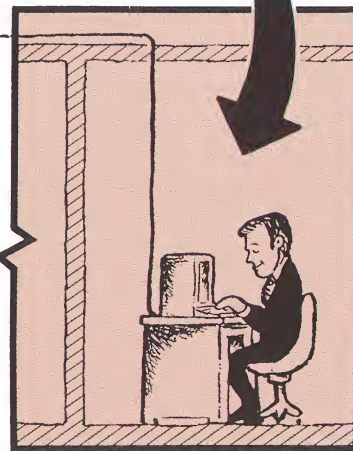
by cybex



- **Select via Keyboard**
- **Dual access up to 250 feet away (optional)**
- **No external power**
- **Mix PC, PC/XT, PC/AT and PS/2**
- **"AutoBoot™" Feature boots attached computers without operator intervention**
- **Shows PC power status**



- **PS/2 Mouse support available**
- **Each unit accommodates from 2 to 8 PCs**
- **Up to 12 units can be cascaded**
- **Mounting kit available for 19" and 24" rack installation**



Dealer Program Available

Cybex Corporation

2800-H Bob Wallace Ave.
Huntsville, Alabama 35805

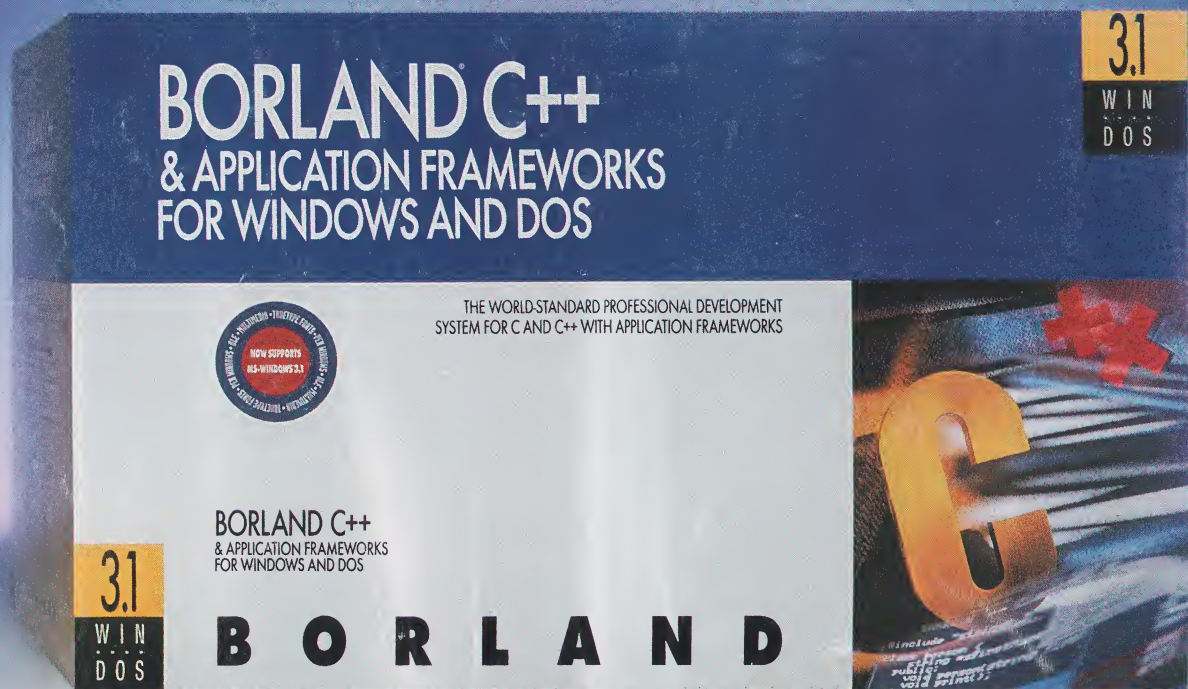
(205) 534-0011

Fax (205) 534-0010

PC, PC/XT, PC/AT and PS/2 are trademarks of International Business Machines Corp.

**New!
Version 3.1**

Get the world standard professional development system



Professional programmers around the world are moving up to Borland® C++. With more than 700,000 C++ products shipped, Borland Language products have earned the trust of leading developers worldwide. Contact your local office to order.

AUSTRALIA 02-953 9500

The world standard professional development system

BELGIQUE/BELGIË 02-4610 448

Le standard mondial des systèmes de développement professionnels

De wereldwijde standaard voor professionele ontwikkelingssystemen

CANADA 1-800-461-3327

The world standard professional development system

ČESKOSLOVENSKO 204 83026

Světový standard mezi profesionálními vývojovými systémy

DANMARK 42-27 64 55

Verdensstandarden for professionelt

FRANCE 1-34 65 60 60

Le standard mondial des systèmes de développement professionnels

DEUTSCHLAND 06103 768-200

Der standard in professionellen Entwicklungssystemen

SUOMI 941-783-344

Ammattimaisen sovelluskehityksen maailmanstandardi

HONG KONG 540 4380

The world standard professional development system

ITALIA 2-26.91.51

Lo standard mondiale dei sistemi professionali di sviluppo

日本 0334861400

世界標準プロフェッショナル開発環境

台灣 2-7186627

世界標準的專業開發系統

MALAYSIA 03-230-2618

The world standard professional development system

NETHERLANDS 020-540-54-00

De wereldwijde standaard voor professionele ontwikkelingssystemen

NEW ZEALAND 09-360 0231

The world standard professional development system

NORGE 225-3350

Standarden innen profesjonell systemutvikling

SINGAPORE 339-8122

The world standard professional development system

ESPAÑA 91-388 30 10

El estándar mundial en sistemas de desarrollo profesionales

SVERIGE 08-799 20 00

Standarden för professionell programutvecklingsjorden runt

대한민국 02-5512795

전문가를 위한 개발시스템의 범세계 표준

RUSSIA (C.I.S.) 959217457

Всемирный стандарт в области профессионального программирования

UNITED KINGDOM 0734 321150

The world standard professional development system

BORLAND

The Leader in Object-Oriented Programming

Copyright © 1992 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. For Borland product information, contact: Japan 0334861400; United States (408) 438-8400; Latin America: Argentina (Softland S.A.) 54-1-354-271; Brazil (A-T Software) 55-11-283-0355; Bolivia (Merisel Latin America) 305-599-7020; Caribbean (Merisel Latin America) 305-599-7020; Central America (Merisel Latin America) 305-599-7020; Chile (Success) 56-2-393-951; Colombia (LASC Ltda) 57-1-256-1538; Ecuador (Merisel Latin America) 305-599-7020; Mexico (Siga Desarrollos) 52-5-687-7582; Paraguay (Merisel Latin America) 305-599-7020; Peru (Merisel Latin America) 305-599-7020; Uruguay (Merisel Latin America) 305-599-7020; Venezuela (Tecnopaxis) 58-2-242-0644 BI 1537A